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II. Central Long Island Ongoing Surveys

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II. CENTRAL LONG ISLAND SOUND DISPOSAL AREA - ONGOING SURVEYS

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II. CENTRAL LONG ISLAND SOUND DISPOSAL AREA ONGOING SURVEYS

1.0 INTRODUCTION

The previous section described in some detail the disposal site monitoring that has taken place over the last several years at the Central Long Island Sound Disposal Site. In addition to that work, a major effort was also conducted at Cap Sites #1 and #2 and at the Field Verification Program (FVP) site (Fig. II-1-1) during 1983 and 1984. Results of the Capping Project were presented as DAMOS Contribution #38 and will be summarized in this section. The next section will present results of the FVP program.

In addition to the work at the Cap Sites, special surveys were also initiated to evaluate the effect of a major storm event which occurred between 29 and 31 March 1984 on the dredged material mounds within the CLIS site and to monitor the overall condition of material throughout the site.

2.0 CAP SITE STUDIES

In 1983, Black Rock and New Haven Harbors were dredged concurrently, and the disposal location for both sites was designated as the Central Long Island Sound Disposal Site. These operations provided an excellent opportunity to duplicate the experiment conducted with the Stamford/New Haven projects in 1979, and to evaluate in more detail the procedures and results of current capping operations and subsequent monitoring techniques.

Based on samples taken by the New England Division (NED) of the Corps of Engineers (NED, 1980, 1982), Black Rock Harbor sediment was classified as a highly contaminated sediment consisting primarily of organic silts and clays with relatively high concentrations of oil, grease and heavy metals, combined with significant, but not excessively high, concentrations of PCB's. Conversely, New Haven Harbor sediments were classified as having moderate to low contaminant levels (NED, 1980) consisting of fine silts toward the head of the harbor and medium to coarse sands near the mouth.

Using these data, a project plan was developed where contaminated sediments from Black Rock Harbor were to be placed at two specified locations within the Central Long Island Sound Disposal Site using point dumping procedures under Loran-C navigation control. The resulting deposits were capped with material from New Haven Harbor; one with silt and the other with sand. The dredging and disposal of Black Rock Harbor material was closely coordinated with the Field Verification Program (FVP), a joint research effort sponsored by the Corps of Engineers and the EPA. In order to provide comparison between the

Figure II-1-1. Central Long Island Sound Disposal Area (CLIS)

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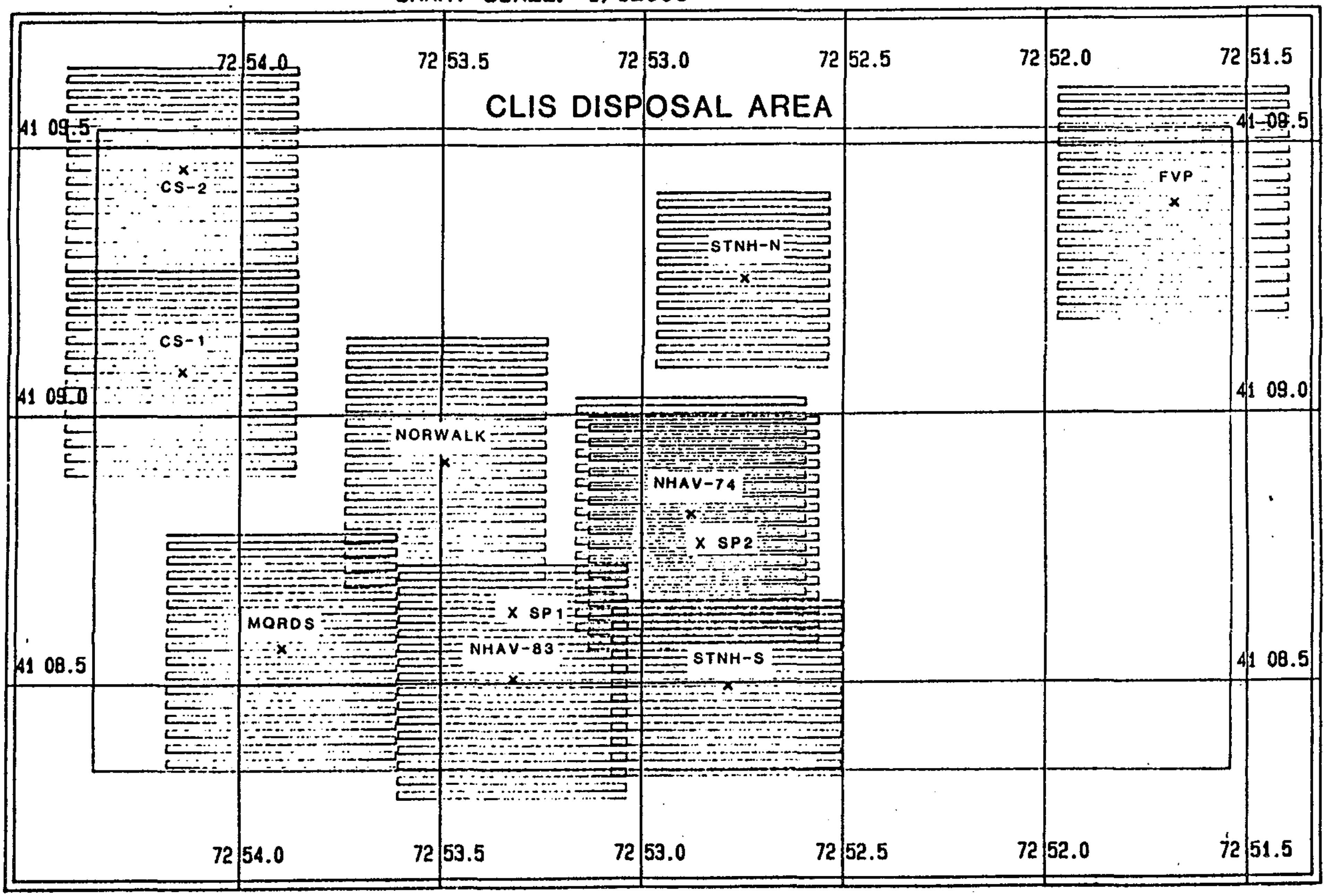


capped and the uncapped sediment used for the FVP, the material to be capped was dredged from areas immediately adjacent to the section used for the FVP program. Likewise, coordination with the New Haven operation was required to insure that the capping be with the desired sediment type and of the correct amount of material.

As shown in Figure II-2-1, two survey grids were established for monitoring the capping operation. The selection of the location of the two Cap Site grids was based on several criteria, including:

- o natural bottom with no previous record of disposal
- o flat bottom for precision bathymetric survey studies
- o sufficiently removed from other sites to reduce potential for contamination by ongoing projects
- o location within the CLIS site to maintain the consistent disposal management policy of the New England Division

As stated above, the capping operation was conducted by depositing material from Black Rock Harbor at each of the sites and then covering the resulting deposit with sediment from New Haven Harbor. At Cap Site #1, the capping material was silt, that was similar in composition to that disposed of at the MQR site, while at Cap Site #2, sand from the outer reaches of the channel was used as the capping material.

2.1 Monitoring of Disposal and Capping Operations

As described in above, concurrent dredging and disposal operations from harbors on the North Shore of Long Island Sound during the Spring of 1983 created a unique opportunity to examine environmental impacts of dredged material disposal in open water and to assess potential management procedures for control of disposal operations.

The proposed sequence of disposal operations at the CLIS site during the spring of 1983 was established as follows:

- o Disposal of 20-30,000m^3 of contaminated Black Rock sediment at a taut-wire buoy at MQR
- o Disposal of approximately 55,000m^3 of contaminated Black Rock sediment at a taut-wire buoy at FVP
- o Concurrent disposal of approximately 1 million m^3 of New Haven silt at MQR under Loran-C control

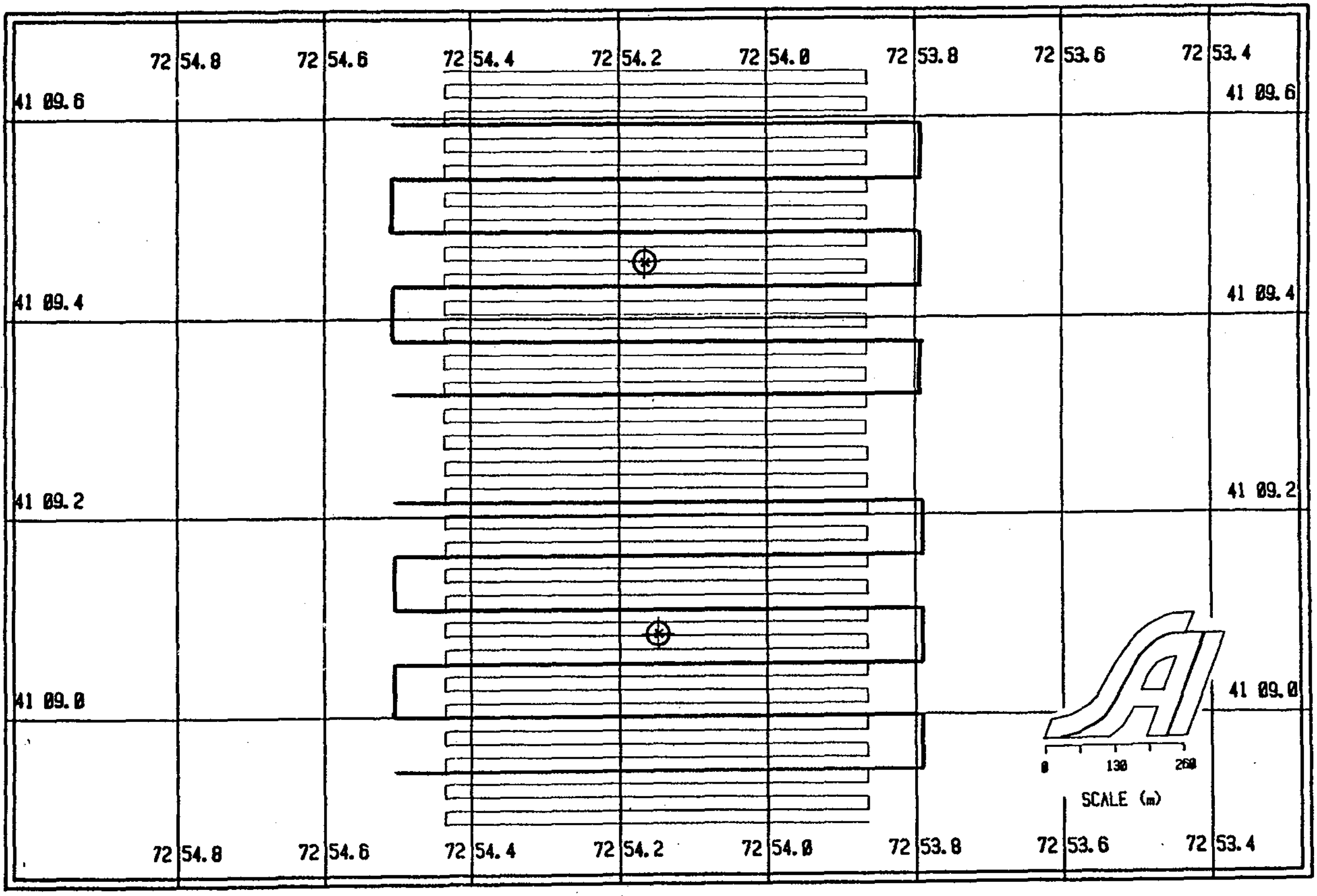


Figure II-2-1 Survey lanes at Cap Sites 1 and 2. Dark lines indicate side scan; light lines represent bathmetry.

- Disposal of approximately 25,000m^3 of contaminated Black Rock sediment at a taut-wire buoy at Cap Site #1
- Disposal of approximately 30,000m^3 of contaminated Black Rock sediment at a taut-wire buoy at Cap Site #2
- Disposal of approximately 60,000m^3 of New Haven silt under Loran-C control at Cap Site #1
- Disposal of approximately 30,000m^3 of New Haven sand under Loran-C control at Cap Site #2
- Disposal of approximately 16,000m^3 of Black Rock sediment at the "SP" buoy

This sequence was established by the New England Division and managed by coordination between contractors and disposal inspectors. Disposal position control was accomplished using two procedures; point dumping at a taut-wire buoy, or use of a computerized Loran-C system. The taut-wire buoy system was used for disposal of contaminated sediments where the primary objective was to reduce the spread of material for future capping operations. The Loran-C system was used to spread the capping material over a larger area and to distribute the large volume of material dredged from New Haven Harbor to prevent excessive shoaling at one point.

The taut-wire buoy design was the same as that used on previous deployments at the CLIS site (Morton, 1982). The buoys are a counterweight design which has several advantages over elastic tether moorings, including increased strength which means that the buoys can survive some contact with the disposal scows, and the ability to move from one point to another without dismantling the entire mooring. Since bottom depths within the CLIS site are all within one meter, the same buoy was used for point dumping of Black Rock sediment at the MQR, CS#1 and CS#2 sites. The buoys were deployed from the R/V UCONN using the SAI Navigation System at a point 25 meters north of the center of the survey grid. Disposal crews were then instructed to dump as close to the south side of the buoy as possible so that the mounds were formed in the center of the survey.

The Loran-C control was a special modification of the SAI Navigation System designed to position the disposal scows as accurately as possible so that a controlled distribution of dredged material could be developed. The system configuration for the New Haven project consisted of two scow units and a single display unit aboard the tug. Each scow system was comprised of a Micrologic Loran-C, a VHF transmitter, and rechargeable batteries. The system aboard the tug had an Apple II microcomputer interfaced to a VHF receiver. The computer generated a display which provided the helmsman with range and bearing to the designated disposal point, and a visual representation of the scows track relative to that point. The disposal location for each scow could be input either automatically or manually, depending on requirements. Each time a scow was dumped, a permanent record of the actual location was recorded on magnetic disk. This Loran-C system was used for disposal of New Haven material at the MQR site and for control of capping operations at the CS#1 and CS#2 sites.

2.2 Baseline Conditions

Prior to disposal, each of the designated sites was surveyed to provide baseline information for comparison with post-disposal conditions. The following sections describe the information determined during those surveys.

2.2.1 Cap Site #1

A baseline bathymetric survey (Fig. II-2-2) of Cap Site #1 was conducted on 7 April, 1983, which indicated a relatively flat bottom sloping only 0.5m from north to south over the survey area. However, due to scheduling and weather problems, this survey was made a few days after disposal operations began and a slight elevation is apparent in the south center of the survey.

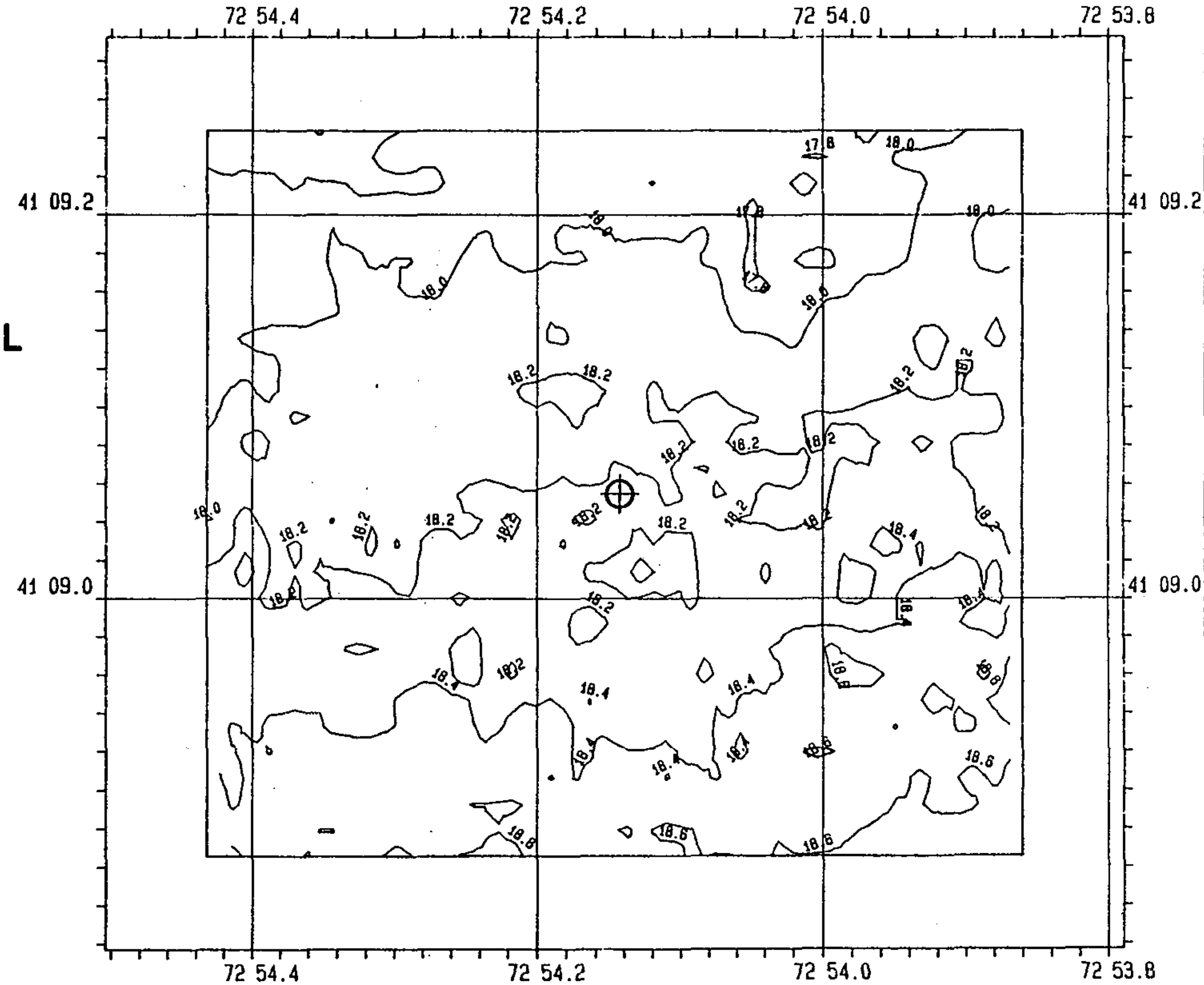
A side scan sonar survey conducted on the same day indicated a predominantly soft, silty bottom interspersed with concentrations of rough, high reflectance sediment. The frequency of occurrence for these high reflectance areas increased toward the east in the general area of permit disposal operations at the "SP" buoy and the previous Norwalk disposal operation. At the extreme east of the survey, the entire surface was composed of high reflectance material.

Previous experience with side scan sonar records in this area (Morton, 1982) and other disposal sites (Menzie et al., 1982) has indicated that dredged material, and particularly that which has recently been disposed, produces a high reflectance signature regardless of the grain size of the sediment. If the dredged material is of a similar fine grained texture as the surrounding material, this high reflectance contrast tends to diminish with time as the sediment is reworked into a surface expression similar to the surrounding deposits.

In the area immediately south of the disposal buoy, dredged material on the bottom produced another area of high reflectance with crater signatures also observed by Menzie et al. (1982) characteristic of the location of actual dumping. The cratering most likely results from initial impact of disposed material on natural bottom producing a sidewards displacement of sediment and some penetration into the bottom. The combination of bathymetric and side scan data obtained at the site supported observations from the research vessel that initial disposal operations were not tightly controlled through dumping with the buoy immediately north of the scow. The importance of this control was re-emphasized to Corps inspectors, and future disposals were much closer to the buoy.

CAP SITE #1
PRE-DISPOSAL
APRIL 1983

Figure II-2-2



0 80 160
SCALE (m)

2.2.2 Cap Site #2

Cap Site #2 was established 700m north of Cap Site #1 to provide a site for capping with sand material. The baseline survey (Fig. II-2-3) indicated a more complex topography than the CS#1 site, but still maintained a slope with a depth difference of one meter from north to south across the site. A shoal area with a topographic relief of one meter is also present in the northeast corner of the site. Sediment samples in that area were of a coarse sand, indicating the possible presence of previous disposal in the area. No side scan records were obtained prior to disposal at CS#2, however, subsequent surveys revealed an original bottom very similar to that observed at Cap Site #1, but with more frequent high reflectance areas and complete high reflectance on the east and northeast margins. Based on these results, it is apparent that both Cap Sites have potential influence from previous disposal operations on the east side of the area. It is important to note that side scan surveys extend beyond the bathymetric survey grids and include areas not considered in other analysis procedures.

2.2.3 REMOTS Observations at CS#1 and CS#2

A REMOTS photographic survey was conducted over both cap sites on 6 April 1983. Eleven stations were sampled at each site with 200 meter spacing over an orthogonal grid. Four replicate sediment profile photographs were taken at each station and three exposures (chosen at random) were measured for baseline parameters with the Measuronics Image Analysis System.

The major modal grain size for all station replicates was 4ϕ, a coarse silt. The range of grain size, exclusive of shell debris, was 4ϕ -3ϕ (silt-clay to very fine sand) with the exception of replicate 1 at station 200N (CS#2) which had some fine sand (2ϕ) present. Both cap sites have a positively skewed boundary roughness frequency distribution.

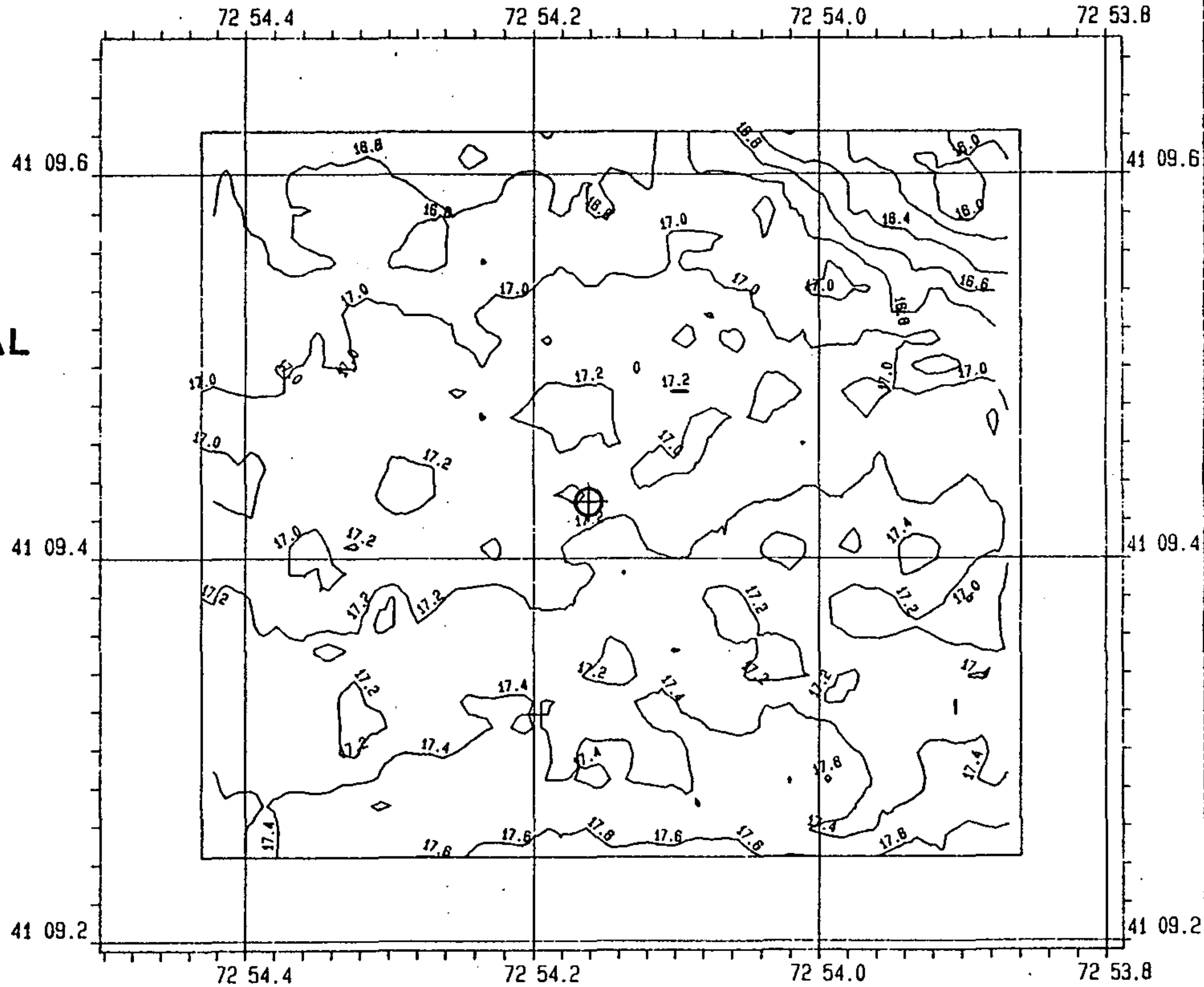
Figure II-2-4 is a map of the mean RPD depth at both capping sites. With the exception of station 400E, all RPD values at CS #1 are greater than 4.2 cm, while only three station means at CS#2 are above this value, indicating possible disturbance of the sea floor in the recent past.

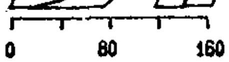
Habitat indices for each station sampled at the two cap sites are presented in Figure II-2-5. Values of 10 and 11 are representative of areas with undisturbed seafloor. In contrast, colonized dredged material disposal areas generally have habitat indices in the range of 1 to 7 with most values falling within the frequency class 4-5. The ambient bottom can also have habitat indices with these values which are caused by local natural disturbances such as current scour or predation activity. Cap Site #1 has only one station (all three replicates of station 400E) which falls within the 4-5 class, while Cap Site #2 has values of 5 at three stations (200N-200E, 200E and 400E). In

CAP SITE #2
PRE-DISPOSAL

APRIL 1983

Figure II-2-3





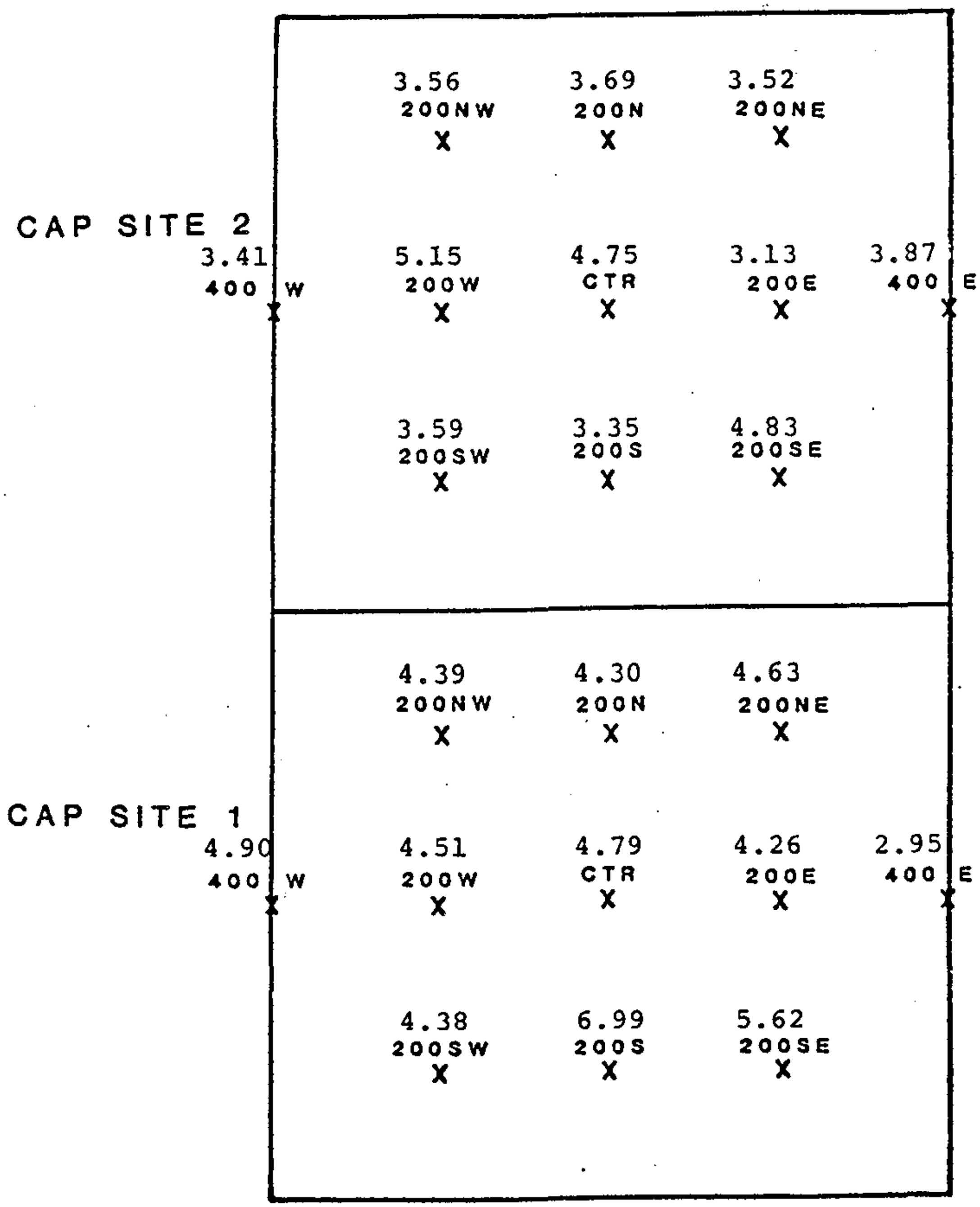


Figure II-2-4. Pre-disposal mean RPD Depth at CS#1, CS#2

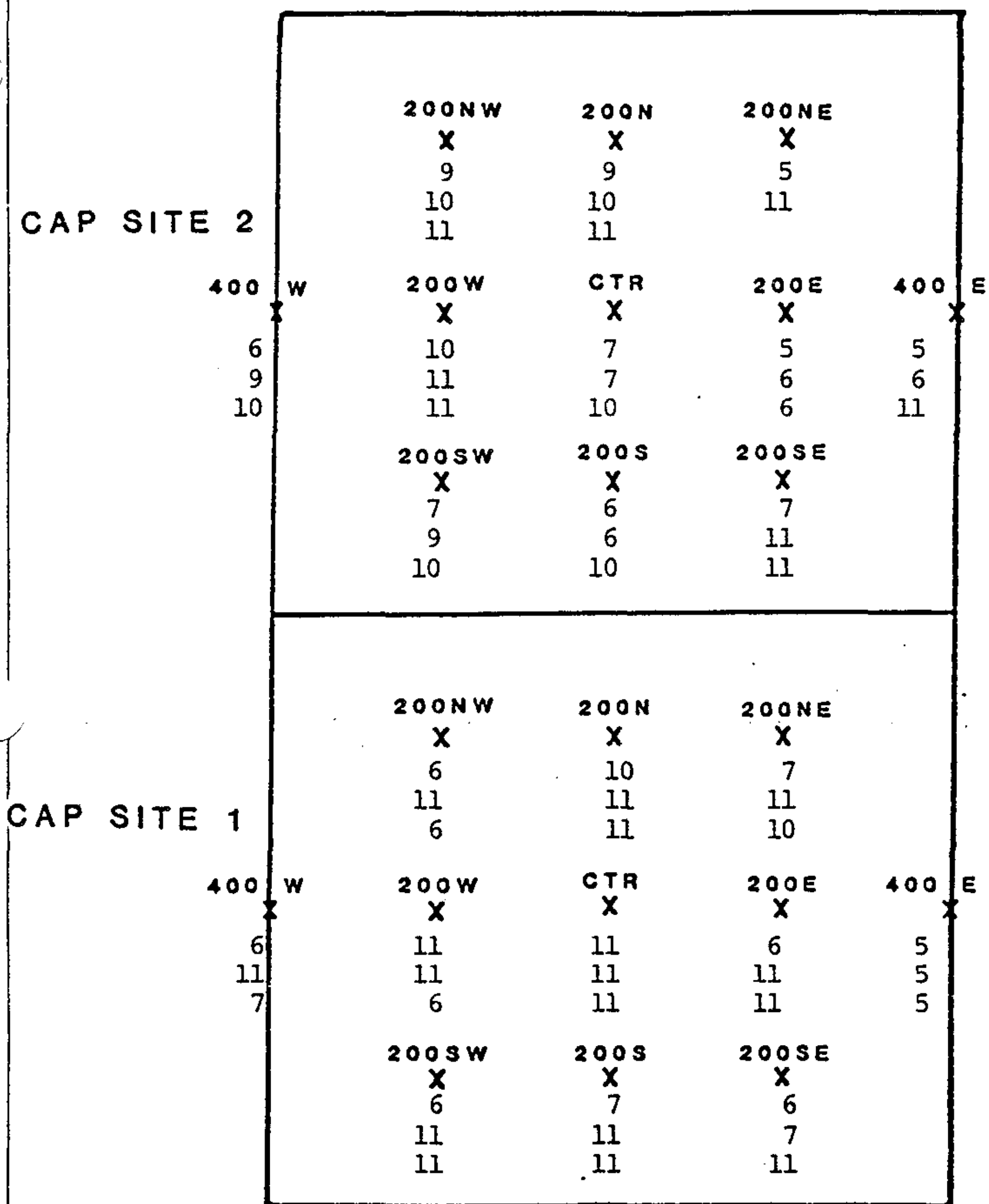


Figure II-2-5. Maps of habitat indices for CS-1 and CS-2. Vaues for each replicate are plotted. Vaues of 10 and 11 represent undisturbed bottoms occupied by high-order successional stages and a deeply oxidized surface sediment. Values of 5 represent recently disturbed habitats.

general, the distribution of habitat index values at the two study sites suggests that CS#1 has a higher habitat value than CS#2, and that the northeastern quadrant of CS#2 (stations 200N-200E, 200E and 400E) are particularly low in their habitat indices, indicating a disturbance has taken place there in the recent past.

2.2.4 Diving Observations at CS#1 and CS#2

In order to observe baseline conditions at the cap sites, a series of five dives at CS#1 and seven dives at CS#2 were made between April 8 and April 18, 1983. Initial dives involved deployment of a 200m long transect array oriented in an east-west direction across the center of each site. The array consisted of a Bottom Deflection Measurement Device (BDMD) located at the center of the transect and four erosion/compaction stakes at distances of 25 and 75 meters east and west of the center. A 200m long transect line marked at 5m intervals was tied to the BDMD and anchored with pipe anchors immediately south of the erosion/compaction stakes.

The BDMD was a 3 meter long steel pipe, welded to a 1.5 square meter plate placed on the surface of the sediment. An acoustic target was then fixed by divers at the top of the pipe so that differences in depth between a known location and the BDMD could be measured over time, thus reflecting changes in the depth of the initial surface following disposal of dredged material. The erosion/compaction stakes were 3 meter long PVC tubes, 5cm in diameter, and marked at 10cm intervals. The tubes were threaded into 1.5meter PVC anchors imbedded in the natural bottom. These stakes were to be used following disposal to measure the thickness of dredged material and to monitor post-disposal changes in sediment thickness. Previous erosion stakes placed in dredged material have indicated, under normal conditions, that no net loss of material due to erosion is taking place on disposal mounds in the CLIS site (Morton, 1982). On this program, the stakes were anchored in the bottom to permit assessment of compaction as well as erosion through post-disposal monitoring of sediment thickness. However, since these stakes were placed after disposal in the dredged material, no measurement of compaction was possible.

Based on visual observations along the transect lines at Cap Site #1, the sediment surface was cohesive, flat and featureless near the ends with small clay clumps and gray sediment indicative of dredged material near the center due to active disposal. Less than 5% of the total surface sediment contained incorporated shell hash material. Surface shell hash may be attributed to recent feeding activity by the Asterias forbessii and Cancer irroratus that were observed during the dive. Bioturbation in the area, from surface tracking and self-burial, is attributed to Cancer irroratus, Pagurus longicarpus and Limulus polyphemus activity. At Cap Site #2, the sediment surface was also cohesive, flat, and relatively featureless with an oxygenated surface layer of 3-5mm. Observable shell fragments accounted for less than one percent of the total sediment surface and may be attributed to minimal feeding activity by Asterias forbesii and Cancer irroratus. Bioturbation was evident, as tracking, over the entire surface by crabs and starfish, and as small decapod burrows. Unlike Cap Site #1, there was no indication of recent disposal activity at this site.

2.2.5 Summary of Baseline Conditions

Based on the results of previous and ongoing studies at the CLIS disposal site, the baseline conditions of the cap site locations can be evaluated in terms of the entire region. In general, the two sites appear to be more recently disturbed than other areas within the CLIS site, however, not to the extent that measurements taken as part of the capping program would be severely impacted. The natural bottom throughout the cap site area generally had habitat indices greater than 9, indicative of a mature, undisturbed sediment surface. However, some areas in the east and northeast sectors showed decreased values in the same locations where side scan sonar records indicate that the bottom has been affected by previous disposal operations.

The flat bottom associated with the disposal sites provides a good basis for replicate bathymetric surveys and the oxidized surface layer of natural sediment provides a distinct boundary on REMOTS photographs to indicate the original bottom prior to disposal. Consequently, future measurements of dredged material thickness should be accurately accomplished. Diving operations were successful in deploying transects with BDMD's and erosion/compaction stakes at both sites.

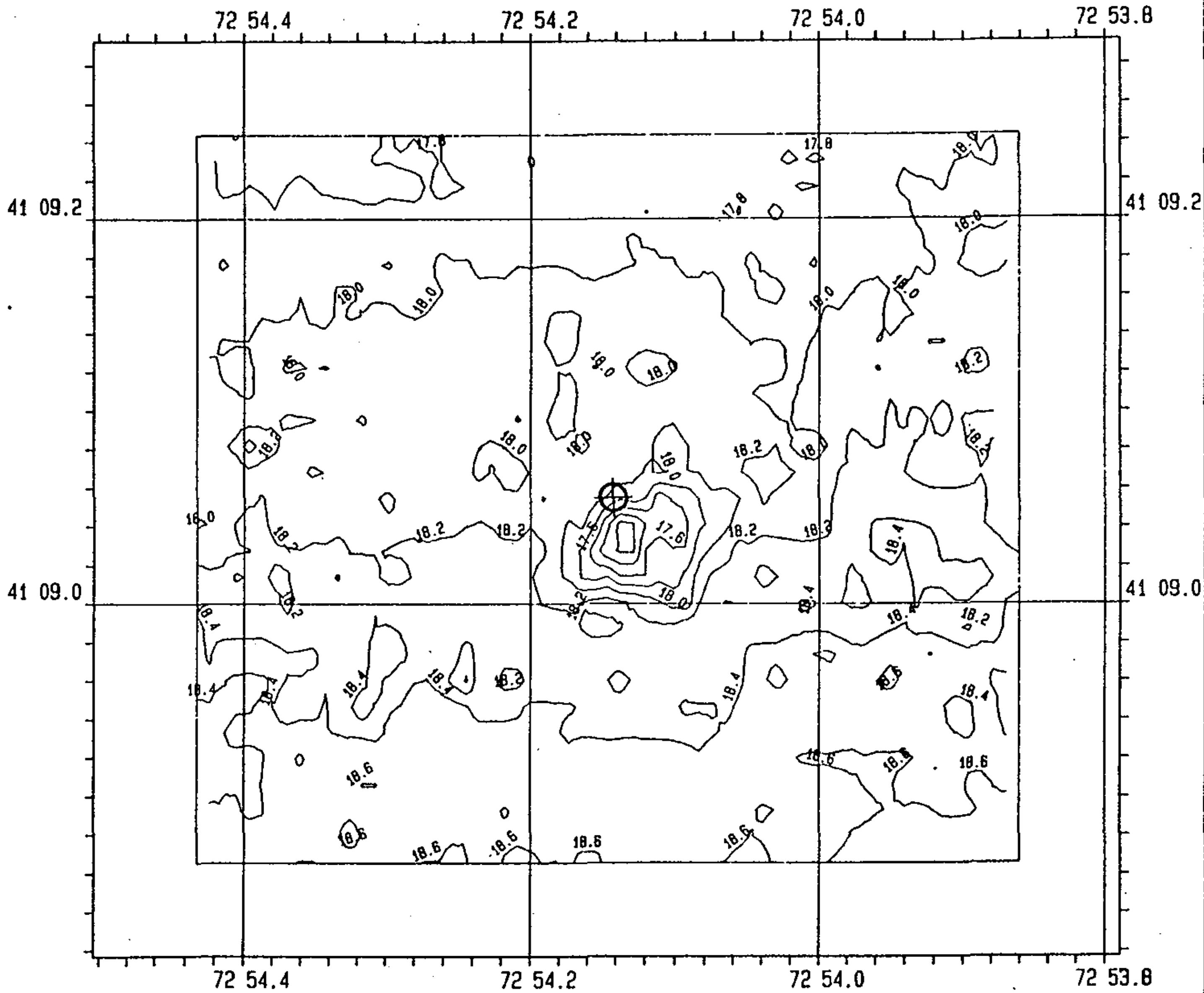
Although most measurements were completed prior to disposal, some disposal of Black Rock material took place at Cap Site #1 prior to the bathymetric survey. Observations of the disposal by personnel aboard the R/V UCONN revealed that these operations were not tightly controlled near the disposal buoy. Consequently, corrections will be made in future surveys to accomodate for this material.

2.3 Interim Surveys

In order to provide data for management of disposal operations, interim surveys and measurements were made on all sites. These were particularly important at the cap sites to insure tight control of contaminated Black Rock material prior to capping. The following sections present the results of these surveys for each disposal site within the CLIS site.

2.3.1 Cap Site #1

An interim bathymetric survey was conducted at Cap Site #1 on 28 April 1983, following completion of Black Rock sediment disposal at the site. The results of that survey, presented in Figure II-2-6, indicate development of a mound approximately 1 meter high with an average diameter of approximately 150 meters. A contour difference chart (Fig. II-2-7) comparing this survey



CAP SITE #1
PRE-CAPPING

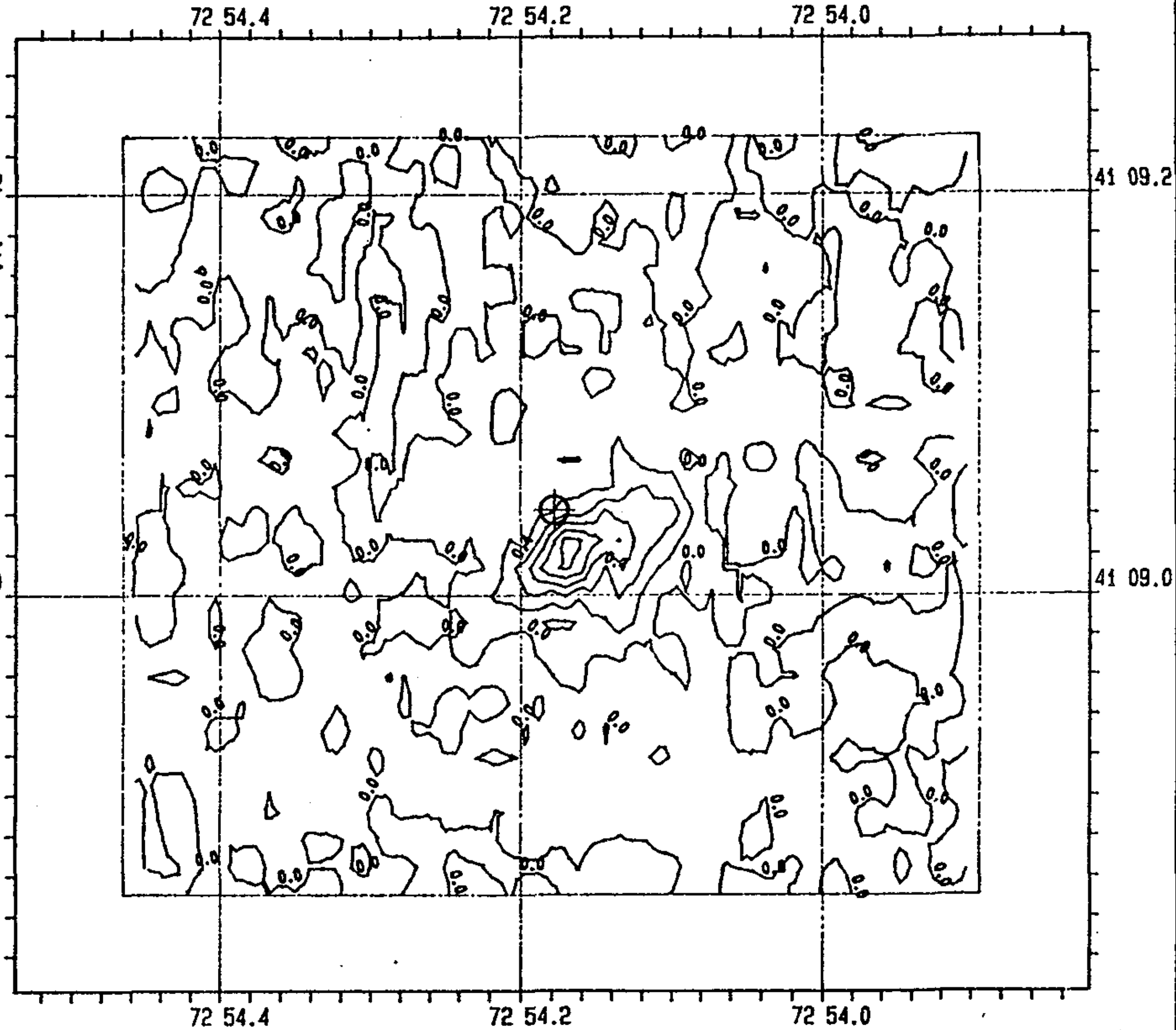
APRIL 1983

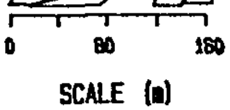
Figure II-2-6

0 80 160
SCALE (m)

VOLUME DIFFERENCE
CAP SITE #1
POST-BLACK ROCK
7-28 APRIL, 1983

Figure II-2-7





with the baseline data indicates similar conditions with most of the material located immediately southeast of the disposal buoy, but extending to the northeast. No topographic expression is evident from the material that was apparently disposed farther south of the buoy during the first stages of disposal.

Diving observations were conducted on 27 April to evaluate dredged material characteristics and to examine the condition of the BDMD and erosion/compaction stakes deployed prior to disposal. The sediment characteristics observed were typical of a post-disposal area. Cohesive, eroded clay and peat clumps, 0.3 - 1.0 meter in diameter, characterized the substrate. Their surface was consolidated and cohesive, yet current erosion was evident around the base of the more stable clumps. The clumps generally had a gray anoxic coloration and the surrounding sediment had a light brown oxygenated veneer (1-2 mm) over a black organic matrix, which was very soft and non-cohesive. The sediment surface consisted of less than 1% exposed shell fragments of oyster, scallop and clam, however, there was also some evidence of coarse material exposed on the mound. Considerable anthropogenic input, i.e. pipes and logs, were noted approximately 75m west of the BDMD. There was no evidence of bioturbation or infaunal colonization on areas covered with dredged material. No distinct conical central pile could be observed from the designated center of the BDMD. Areas northeast, south, and west of the center were flat and uniform, and there was no dredged material coverage along the first 10m of the east transect leg. At this point, dredged material coverage was approximately 1.5 m at the BDMD and no declining slope was observed.

Only the BDMD and the first 10m of the eastern line of the erected transect array that was completed on 8 April 1983, were located during this study. Sweep searches were conducted for all the 10 foot PVC compaction stakes and none were successful. It must be assumed that either the array did not sustain direct impact by the barge loads and the stakes were sheared off by the resulting outward flow of material, or that the stakes may have been dislodged by commercial fishing traffic.

2.3.2 Cap Site #2

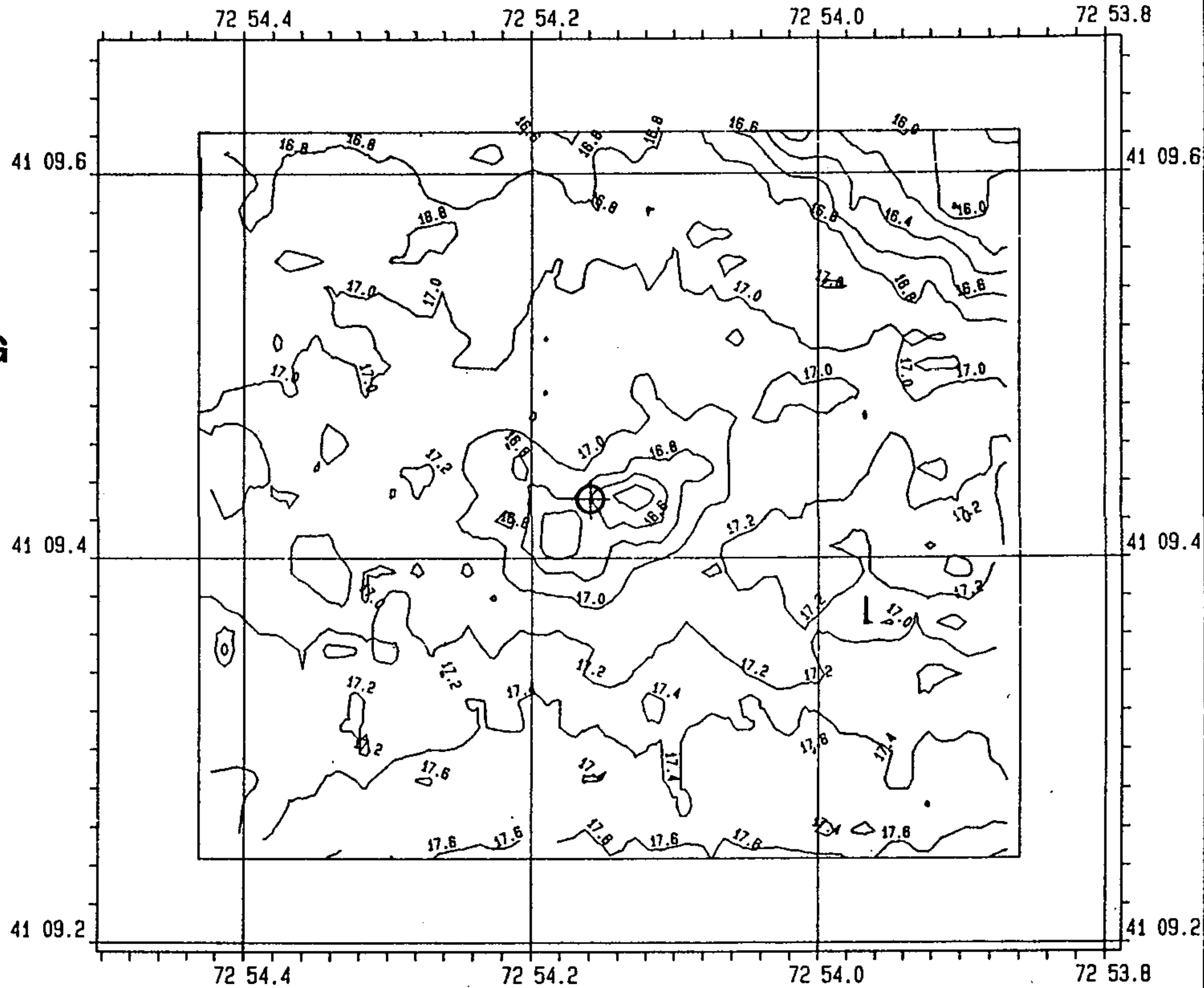
Following completion of disposal of Black Rock dredged material at Cap Site #1, the disposal buoy was moved to its Cap Site #2 position and further disposal took place at that point. During disposal at Cap Site #2, an interim survey was conducted on 28 April 1983 (Fig. II-2-8). The contour chart of that survey revealed the formation of an elliptical mound approximately 60 cm thick at its maximum elevation and extending 250m on an east-west axis and 125m on a north-south axis. The contour difference chart (Fig. II-2-9) verified the distribution of sediment close to the disposal buoy. Additional disposal continued after this survey until 18 May; consequently, the full distribution of Black Rock sediment at this site is unknown.

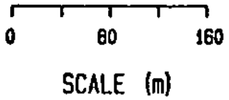
A side scan survey conducted over this site on 11 May

CAP SITE #2
PRE-CAPPING

APRIL 1983

Figure II-2-8

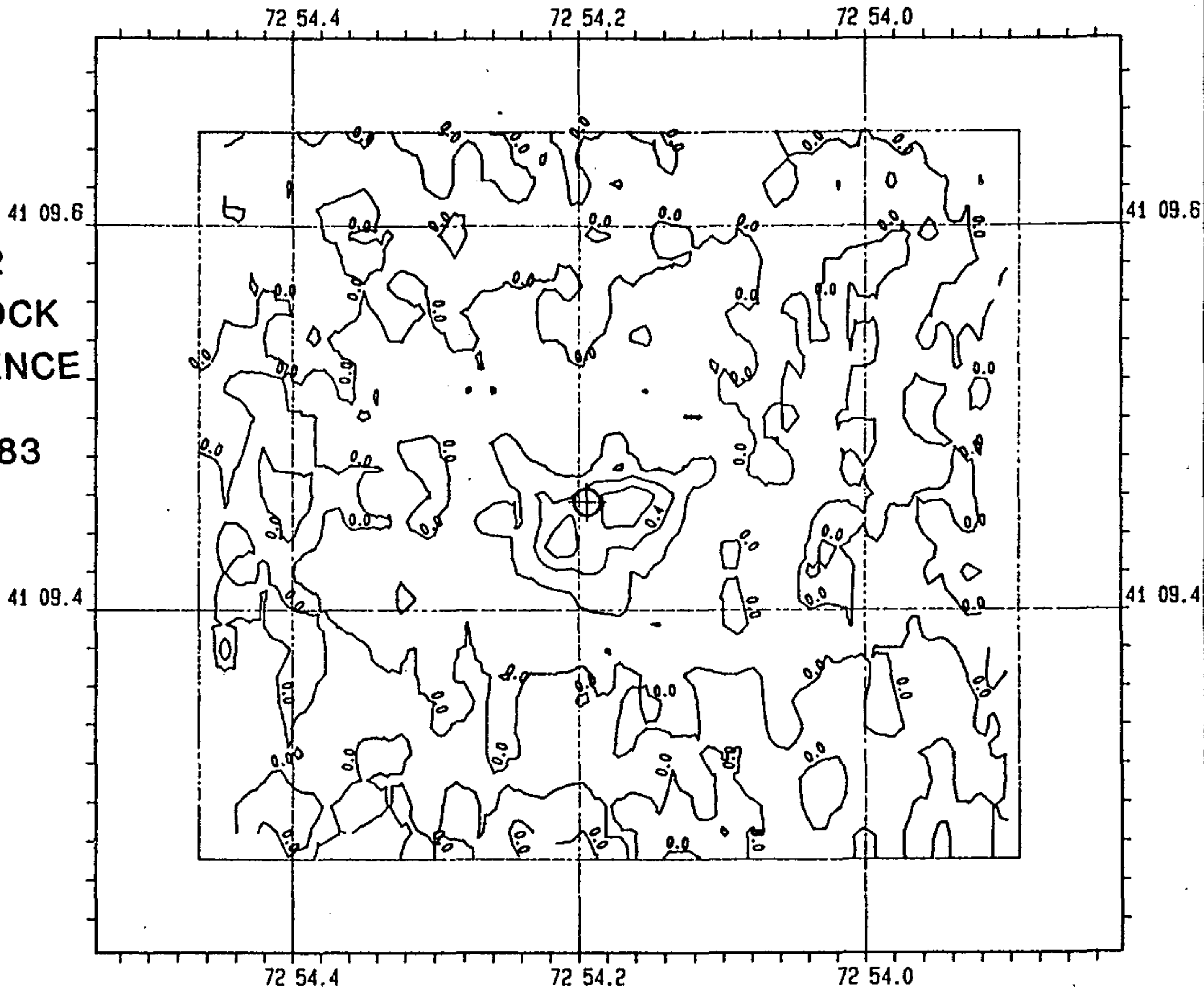




CAP SITE #2
POST BLACK ROCK
VOLUME DIFFERENCE

7-28 APRIL, 1983

Figure II-2-9



0 80 160

SCALE (m)

1983 produced results similar to those observed at Cap Site #1, however, the high reflectance areas associated with dredged material were more pronounced in the center of the site indicating satisfactory positioning of disposal operations. In addition, high reflectance areas were present in the east and northeast positions of the site, indicating some previous disposal.

Diving observations at this cap site also resulted in a loss of the erosion/compaction stakes although the BDMD was found intact at a later date. The sediment observed at this location was similar to that at Cap Site #1, and although no mounding or slope could be detected, the material was more prevalent in the vicinity of the disposal buoy.

2.3.3 Summary of Interim Conditions

The primary objective of the interim surveys was to evaluate the condition of Black Rock sediment during disposal to insure that distribution over the bottom could be sufficiently controlled to permit future capping operations. In general, the results indicated that such an operation would be feasible since relatively small mounds were created at all locations. Some caution should be exercised, however, since the sediment appeared to be a combination of typical dredged material with cohesive gray clumps and coarse grained sediment that was interspersed with a soft, non-cohesive matrix with the potential to spread over larger areas. However, evidence from side scan surveys and sediment samples from the FVP site indicate that such spreading is not significantly more extensive than that observed on previous disposal operations at this site (Morton, 1979).

In summary, the interim surveys supported the expected conditions and indicated that capping of contaminated Black Rock Harbor sediment with New Haven material was a feasible operation.

2.4 Post-Disposal Surveys

Immediately following completion of dredging and disposal, a series of surveys were conducted to assess the results of the disposal operations and to establish a new baseline for post-disposal monitoring procedures. The following sections present the results of those studies.

2.4.1 Cap Site #1

Capping operations designed to cover Black Rock Harbor sediment at Cap Site #1 with silt from the upper portion of New Haven Harbor were conducted over a period from 18 April to 23 May 1983. Disposal took place with large scows and Loran-C disposal control systems. Since the mounds created by the point dumping of Black Rock material were quite small, a decision was made to input only one disposal location to the computer. Assuming a random distribution of positioning errors about this point, it was felt that adequate distribution of capping material would be accomplished. However, records of the Loran-C controlled disposal and the resulting disposal mound indicate that most material was deposited southwest of the designated point.

A post-disposal monitoring survey during June 1983 (Fig. II-2-10) and the contour difference chart (Fig. II-2-11), derived from a comparison of the June and April surveys, indicate that the deposition of cap material took place slightly to the southwest of the Black Rock sediment. The resulting mound is approximately 250 meters in diameter in a southwest-northeast direction and 175 meters on a perpendicular axis. However, the NE 50 meter segment of the mound is essentially unchanged in depth indicating that no significant coverage in that area was accomplished. Based on these data, insufficient capping of Black Rock material, particularly on the eastern margins of the mound, has occurred.

A side scan survey of the area provided little additional information relative to the distribution of material as there are no significant differences between the acoustic reflection of the Black Rock and New Haven dredged material. Diving observations at Cap Site #1 indicated that general sediment conditions three weeks after the last disposal operations were atypical of recently dumped material. The sediment surface was a flat, featureless, soft, oxidized mud with only a patchy distribution of 10-100 cm clay clumps, and 1 year old scallop shells. The top 1 cm of sediment was easily suspended by agitation and below 2-3 cm was aerobic and black in color. Below 2 cm, the sediment was cohesive. There was no apparent bioturbation at this stage. A typical description of recently dumped material would consist of more topographic relief, composed of clay clumps interspersed with a fine matrix of dredged material. Based on these observations, dives were probably conducted over uncapped Black Rock sediment.

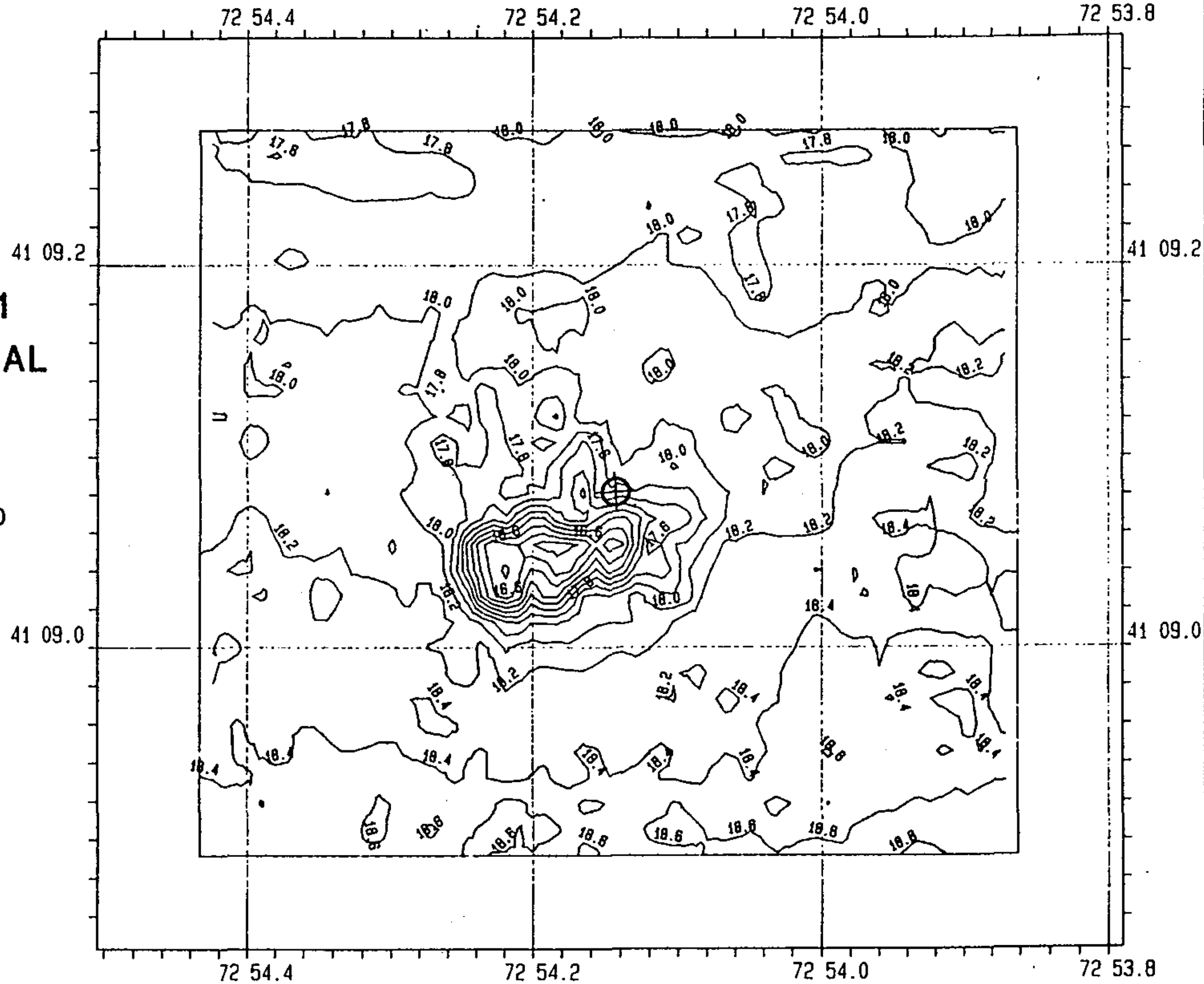
On 29 June 1983, five weeks after completion of the capping phase at this disposal site, an erosion stake array was deployed at the center of the site. A 75m east/west transect line was positioned over the sediment with 25m east of the center and 50m west of the center. Seven 1 meter, 3.8cm diameter erosion stakes were positioned so that exactly 30cm were above the sediment/water interface and 70cm were driven into the sediment. After this deployment, the BDMD pole was located 10m north and 15m east of the center of the erosion stake array.

2.4.2 Cap Site #2

A similar situation developed at Cap Site #2 as a result of disposal operations conducted in the same manner as those at Cap Site #1. The results of capping with sand from the outer portion of New Haven Harbor are presented as a contour chart in Figure II-2-12 and a contour difference chart in Figure II-2-13. As in the Cap Site #1 situation, most of the material was deposited south and west of the disposal point and, although there is coverage over the entire Black Rock deposit, it is only

CAP SITE #1
POST-DISPOSAL
JUNE, 1983

Figure II-2-10

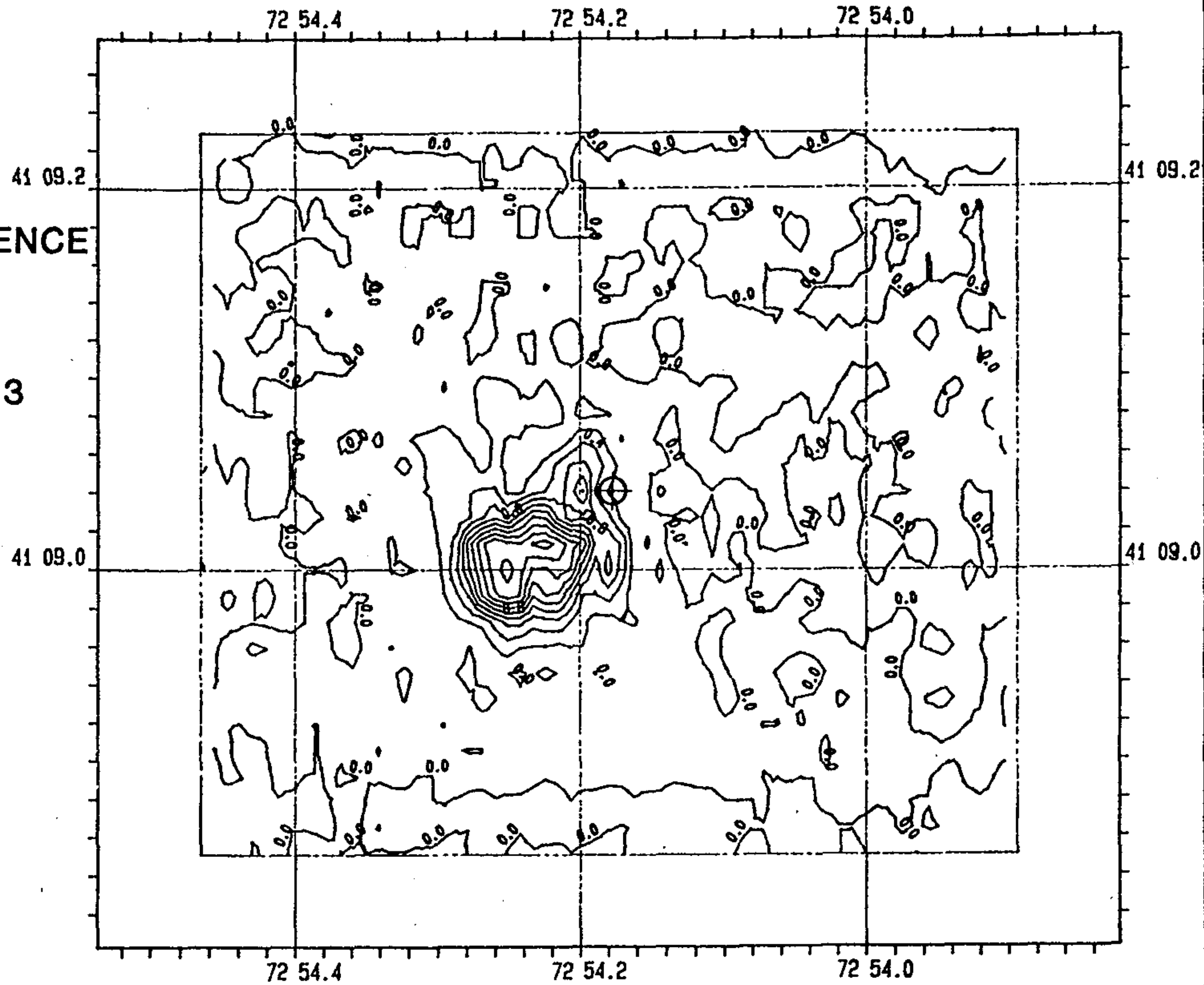


0 80 160

SCALE (m)

VOLUME DIFFERENCE
CAP SITE #1
CAPPING
APRIL-JUNE, 1983

Figure II-2-11



0 80 160
SCALE (m)

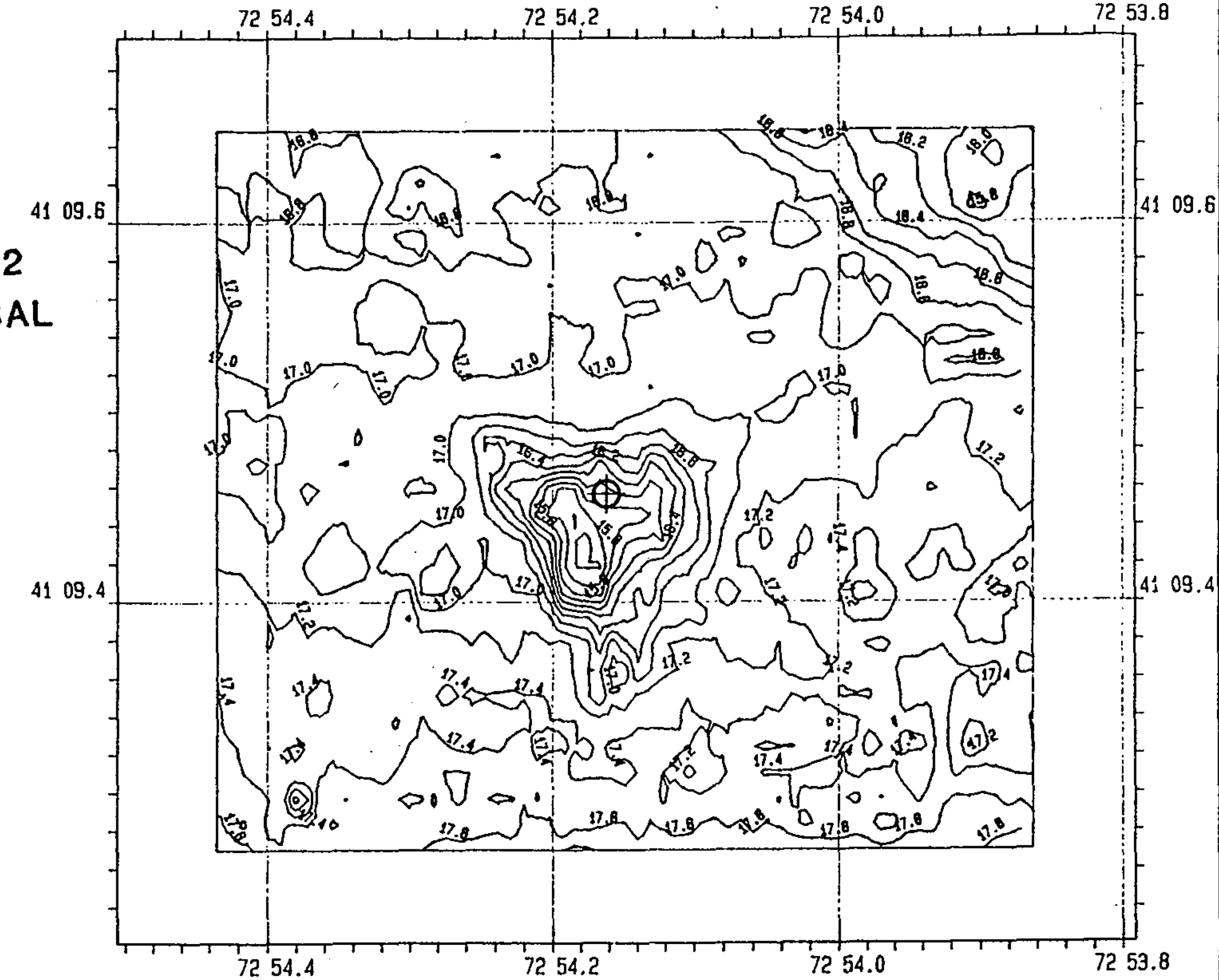
CAP SITE #2
POST DISPOSAL

JUNE, 1983

Figure II-2-12

0 80 160

SCALE (m)



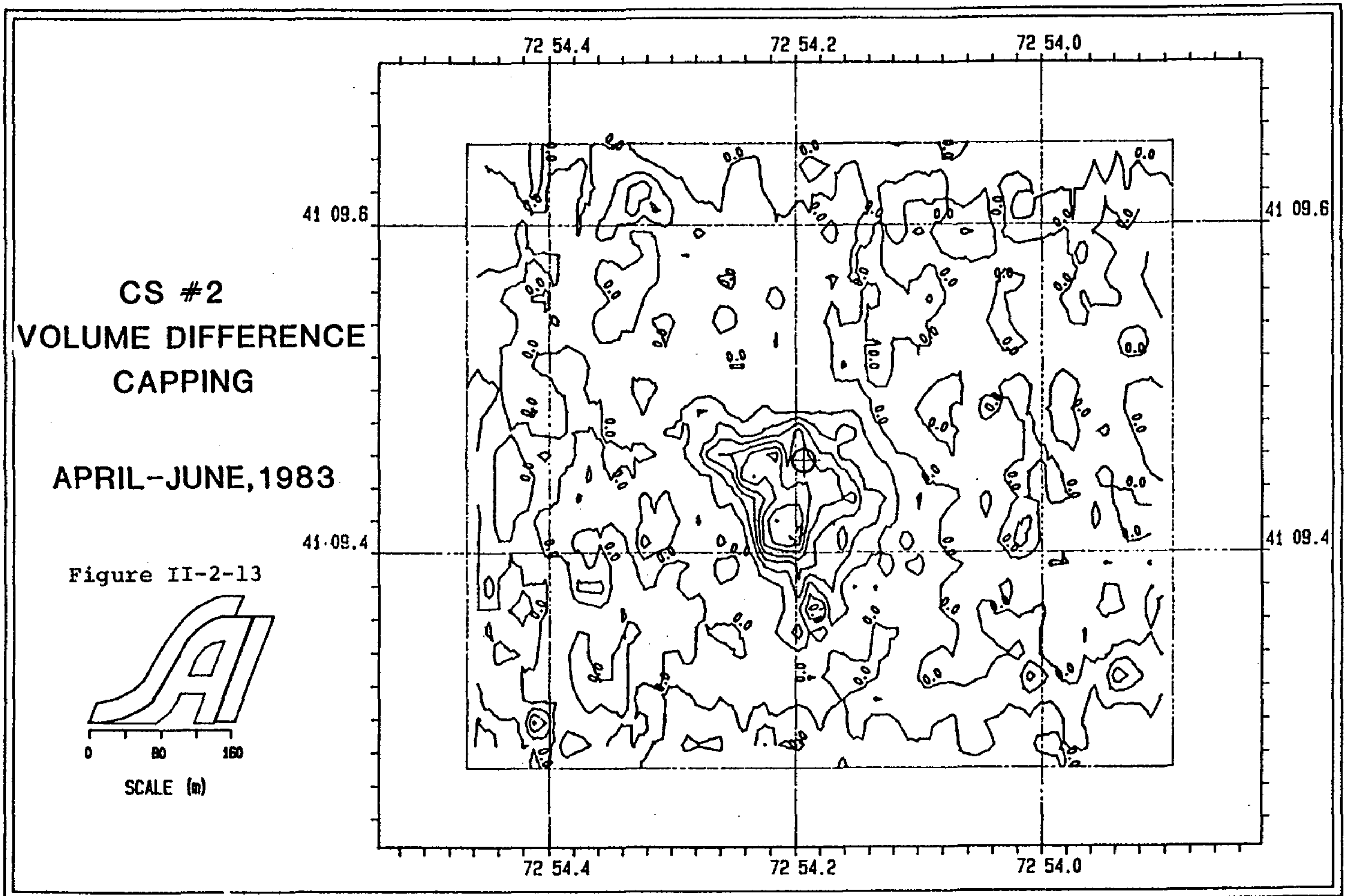


Figure II-2-13

20-40cm thick on the eastern borders while it may be as much as 1.4 meters thick on the western margin. The resulting mound is roughly shaped as an equilateral triangle, pointing south from the disposal point with sides approximately 250 meters in length.

A post-capping side scan survey also revealed conditions similar to Cap Site #1 with the mound identified as a very strong reflector in the center of the survey. The strong reflectance associated with sand deposits and the cratering characteristic of disposal operations were evident on this record, providing supporting evidence of a relatively small aerial distribution of the mound.

Diver observations at this site indicated that sediment surface conditions near the center of the site consisted of 2 cm of fine sand over a layer of hard sandy gravel. The fine sand had obvious current ripples running north/south, with a crest to crest period of 5-8 cm and 2-3 cm trough. This sediment type was not uniform over the whole center of the site. Surface distribution of shell fragments, clay clumps and anthropogenic input was patchy, but prominent during every diver transect. Shell hash was incorporated into both clay and sand material. Some randomly distributed clay clumps, 10-30 cm in length, were of high organic content (black in color), with a 2 mm brown oxidized veneer. Anthropogenic input included wood debris, scraps of metal and clothing. General topography of the site was marked by rapid 1-2 m changes in slopes. The only obvious bioturbation of the sediment was at the periphery of the dredge material where four lobster burrows were observed under a 30-foot piling and <u>Asterias forbesii</u> was observed during foraging activity.

An erosion array was deployed on 22 June 1983 for monitoring over the long term post-disposal period. A 50 m line was positioned due west from the BDMD and one meter long erosion stakes were driven into the sediment to a depth of 70 cm. These erosion stakes are PVC pipes graduated in centimeters so that they can be read during future diver surveys.

2.4.3 REMOTS Observations at CS#1 and CS#2

A REMOTS photographic survey was obtained at both cap sites following completion of disposal to assess the distribution of material and to evaluate the thickness of capping deposits over Black Rock sediment. On 13 June 1983, 11 stations were sampled at each cap site. These were the same stations occupied in the pre-disposal survey of 6 April 1983 (Fig. II-2-4). The results of this initial survey were used to determine additional stations so that the second survey, made on 14 June, was able to cover the full perimeter of the dumped area. On 14 June 1983, 36 additional stations were sampled, making a total of 58 stations. One sample was taken at each station to determine the thickness of Black Rock sediment and the overlying cap material. Thicknesses exceeding the length of the REMOTS prism window are indicated on subsequent figures by a " " preceding the penetration value for that station. All of the flank regions of the mounds were less than 19 cm deep; therefore, an accurate map of most of the disposal stratigraphy could be developed.

The pre-disposal surface was recognized by the presence of an oxidized (high reflectance) mud buried below the low reflectance Black Rock harbor sediment. The sandy material from CS#2 was also easily recognized as its grain-size was much coarser than the silt-clay of the underlying Black Rock material. The cap material at CS#1 was "clean" mud, which was visually indistinguishable from the underlying Black Rock sediment. Thickness measurements of the sand cap and Black Rock sediment were made with the Measuronics LMS Image Analysis System to the nearest millimeter. These measurements represent the average thickness of the units of interest in each photograph. Areas and perimeters of Black Rock sediment and capping materials were also measured from the isopleth maps generated from thickness data with the LMS System.

Figure II-2-14a gives disposed material thickness at each station within CS#1 (n=27), and Figure II-2-14b is a contour map of those values. The thickness values and contours for CS#1 represent the thickness of both the Black Rock sediment and capping material, since it is impossible to separate these two materials based on their reflectance values.

Figure II-2-15a shows Black Rock sediment thickness and sand cap thickness values for each CS#2 station (n=31), and Figure II-2-15b is a contour map of the Black Rock material. The perimeter of the zero isopleth, and area of the 0-2 cm contour interval, depend heavily on interpretation of the REMOTS photo from station 400E. This appears to be an area which has experienced recent disturbance either through disposal or erosion. The boundary roughness is high (2.3 cm), no sand is present, and the characteristically black (low reflectance) Black Rock harbor silt-clay is apparently not present. The sediment observed at station 400E is a high reflectance mud; however, the origin of the sediment is unknown. This deposit may represent New Haven silt designated for disposal at the CS#1, MQR or "SP" sites, or may be a remnant of previous disposal at the Norwalk disposal site as indicated by the high reflectance values observed on the side scan records in this area. Until further data are available, this sediment has arbitrarily been eliminated from consideration as Black Rock material.

Figure II-2-15c is an isopleth map of the sand cap thickness. The grain-size composition of the underlying Black Rock sediment is uniformly a silt-clay ($> 4\phi$). The capping sand appears to be uniformly spread over the surface and is easily detected in the REMOTS photos because of its markedly different texture and reflectance value.

In summary, the REMOTS data provde information on overall spread of dredged material from Black Rock harbor, indicating results similar to those obtained at the FVP site, where sediment samples during the interim surveys indicated

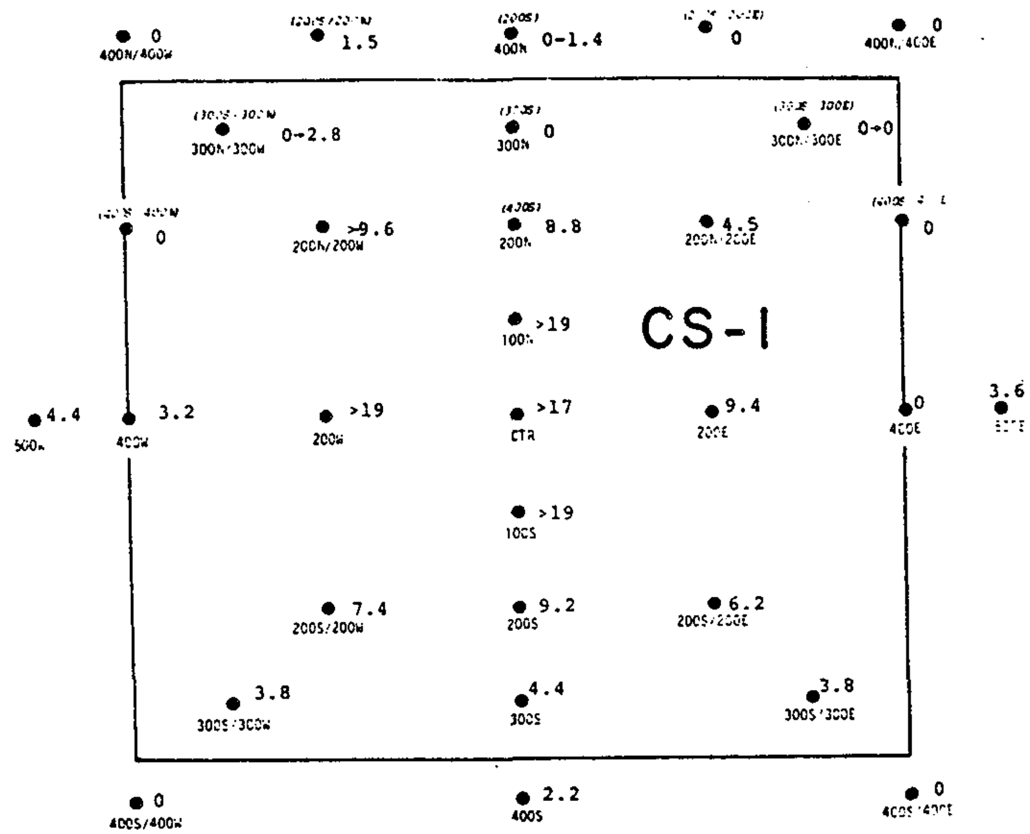


Figure II-2-14a. Station locations (from CS-1 center in meters) and thickness of dredge material. Values in centimeters. One photo per station, except for the 3 stations where two values are printed.

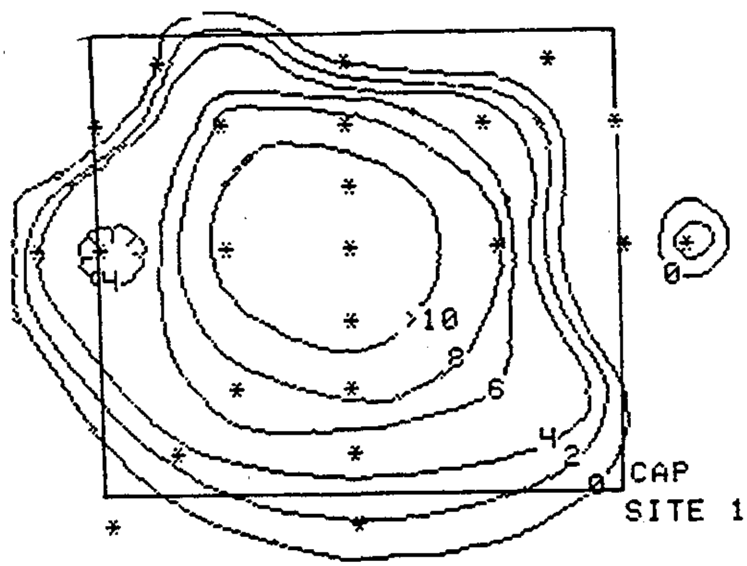


Figure II-2-14b. Isopleth map of dredge material thickness, (in centimeters) at CS-1. Contour interval is 2 cm.

CS-2

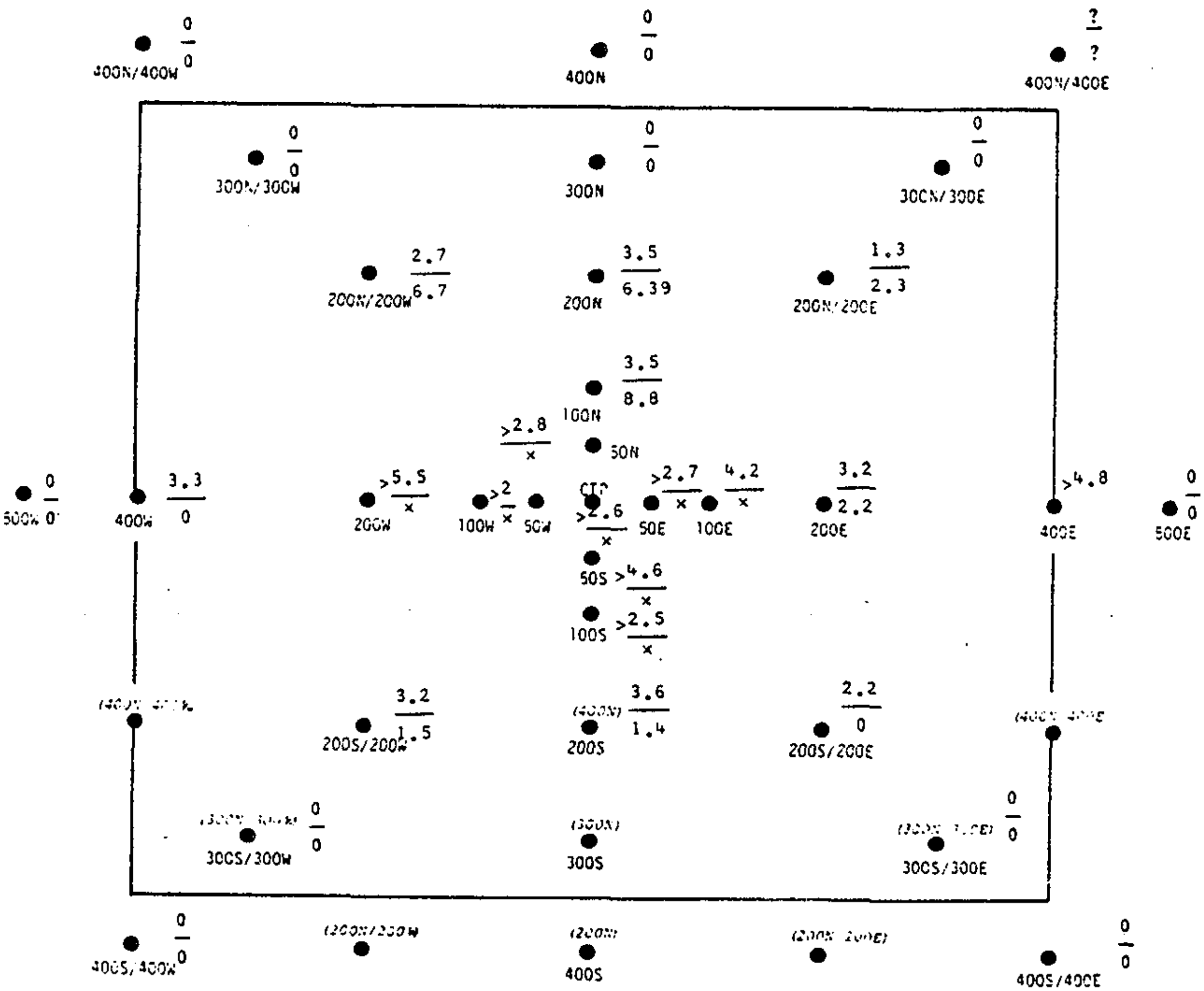


Figure II-2-15a.
Station locations (from CS-2 center in meters) with thickness (in centimeters) of sand cap (numerator) over thickness (cm) of Black Rock material (denominator). Values of material thickness given as (x) are unknown due to size limit of camera prism or inadequate penetration.

SAIC

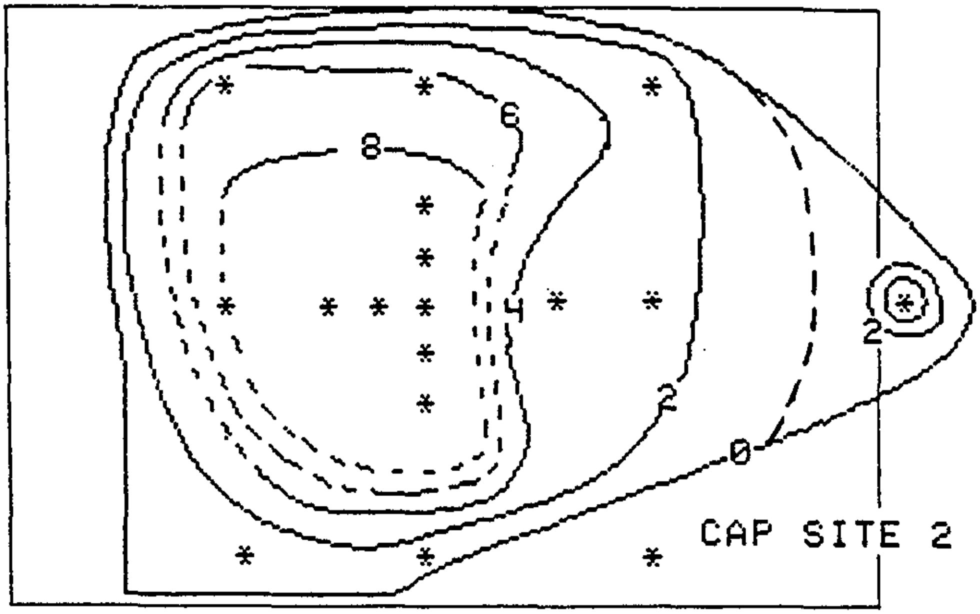


Figure II-2-15b.
Isopleth map of Black Rock sediment thickness (in cm). Contour interval is 2 cm. Dashed line denotes probable extent of Black Rock Material.

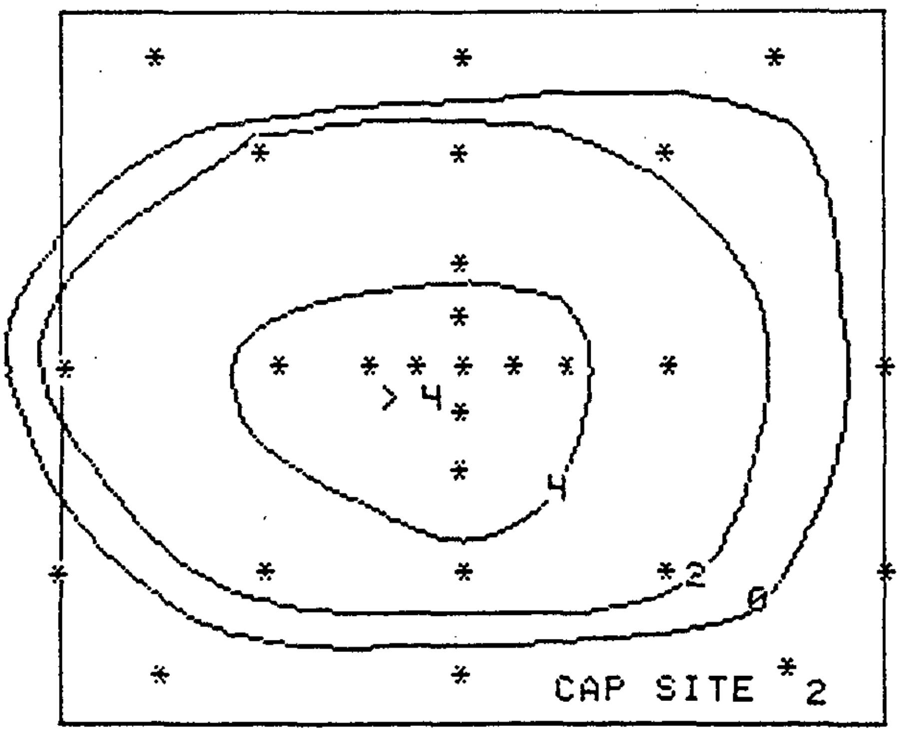


Figure II-2-15c.
Isopleth map of sand cap thickness (in cm) at CS-2. Contour interval is 2 cm.

material present to a radius of 2-300 meters from the disposal point. In addition, these data permit an assessment of the effectiveness of the sand cap in covering the Black Rock material, and indicate that a uniform cover of 2-4 cm on the flanks of the CS#2 mound has been achieved with greater thickness near the center of the site. A limitation of the REMOTS and other visual measurements is the lack of discrimination between Black Rock and New Haven sediment at Cap Site #1. Under those conditions, sediment sampling and subsequent chemical analysis remain the only method for distinguishing such material.

2.4.4 Summary of Post-Disposal Conditions

The results of the capping operations were not successful in fully covering Black Rock material, particularly at the CS#1 location. Although complete coverage was attained at the CS#2 site, the thickness of sand material on the eastern border was less than desirable, and may not be adequate to insure capping following post-disposal reworking and bioturbation. The reasons for this are primarily related to disposal control problems which resulted in deposition of both the silt and sand caps to the south and west of the desired location. The causes of this lack of control are not entirely clear, but it is obvious that when conducting small scale capping operations, extreme care in disposal position and frequent monitoring of results are required to insure coverage. In the future, scows with capping material should approach the disposal point from the same direction as those dumping the contaminated material, and at least one interim survey should be conducted during the capping operation to assess the distribution of material.

In spite of these problems, studies of capping parameters can still be conducted since the geotechnical properties of the sediments remain unchanged and some effective capping has taken place at both sites. It appears that disposal of New Haven material at the MQR and Black Rock sediment at the FVP sites was successful, and that important data concerning the behavior of the respective sediment types under controlled dredging and disposal conditions can be applied to the capping project.

Special care must be taken to insure that influence from previous or ongoing disposal operations do not affect the results of this study. In particular, the presence of Norwalk and "SP" disposal sites to the east may have been detected in side scan and REMOTS data and interpretation of results should consider this information.

2.5 Post-Disposal Monitoring

The effectiveness of capping operations depends to a large extent on the long-term stability of the sediment placed at the disposal site to cover the contaminated sediment. Consequently, post-disposal monitoring of these sites is of critical importance to evaluate the success of the procedure. The following sections provide a summary of post-disposal monitoring results during the summer and fall of 1983.

2.5.1 Cap Site #1

A replicate bathymetric survey of the Cap Site #1 area was conducted on August 23, 1983, which resulted in the contour chart shown in Figure II-2-16. A comparison with the post-disposal survey from June, 1983 indicates no apparent changes in the shape of the mound, and the contour difference chart (Fig. II-2-17) indicates virtually no difference over the entire survey.

Sediment samples and diver observations on the site revealed a smooth sediment surface with an oxidized layer beginning to form in the upper portion of the sediment column. After four weeks, there had been no change in the erosion stake readings, thus indicating that there is no observable monthly erosion by this type of disposal material during the early summer season.

2.5.2 Cap Site #2

A similar survey at Cap Site #2 was conducted on the same day to assess stability of the sand cap. The contour chart (Fig. II-2-18) shows some change from the June survey, and the difference chart (Fig. II-2-19) indicates an area of depression relative to the post-disposal survey near the west center portion of the cap at the point of highest elevation and greatest thickness. Based on these data alone, we cannot at this time relate this change in depth to either erosion or compaction of the mound.

Diver observations of sediment surface conditions at this site revealed heavy natural deposition since the sandy New Haven dredge material was used to cap the Black Rock Harbor sediments. At this date, a flocculent 2 cm layer of soft sediment was present over a hard sand/gravel layer. At mid-day flood current of 13cm/sec (0.25kt), this sediment condition created a bottom visibility of only 1 meter. Some eroding clay clumps, presumably of the Black Rock Harbor dredge material, were observed at a 1 per 5 m^2 density with patchy distribution. This provides evidence of thin or incomplete capping operations with the New Haven material. The average clay clump was approximately 25 cm in diameter and light brown in color due to an approximately 2 mm oxidized veneer. One clay clump had an obvious peat constituent with what look like *Spartina* rhizoids eroding through one side. No biological activity was associated with the clay clumps, but substantial amounts of motile species were seen nearby on the recent natural sediment. The general topography was flat except for an area of steep (1:5) westerly slope that was encountered halfway along the transect. The divers did not follow down this slope, but it was estimated to be an elevation change greater than 3 meters. Anthropogenic deposits in this area were represented by a piece of a steel rod,

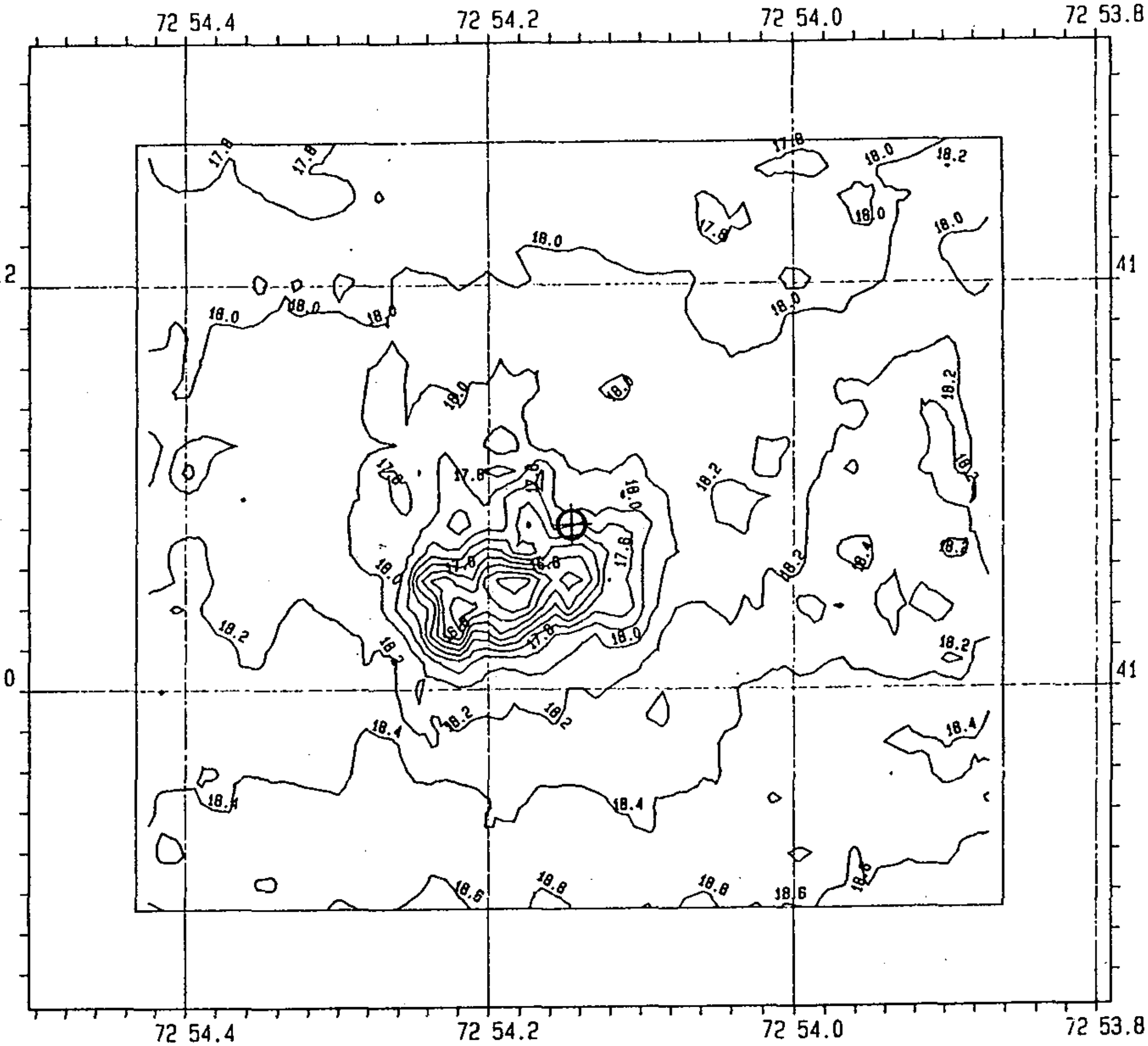
CAP SITE #1 POST-DISPOSAL MONITORING

AUGUST 1983

Figure II-2-16

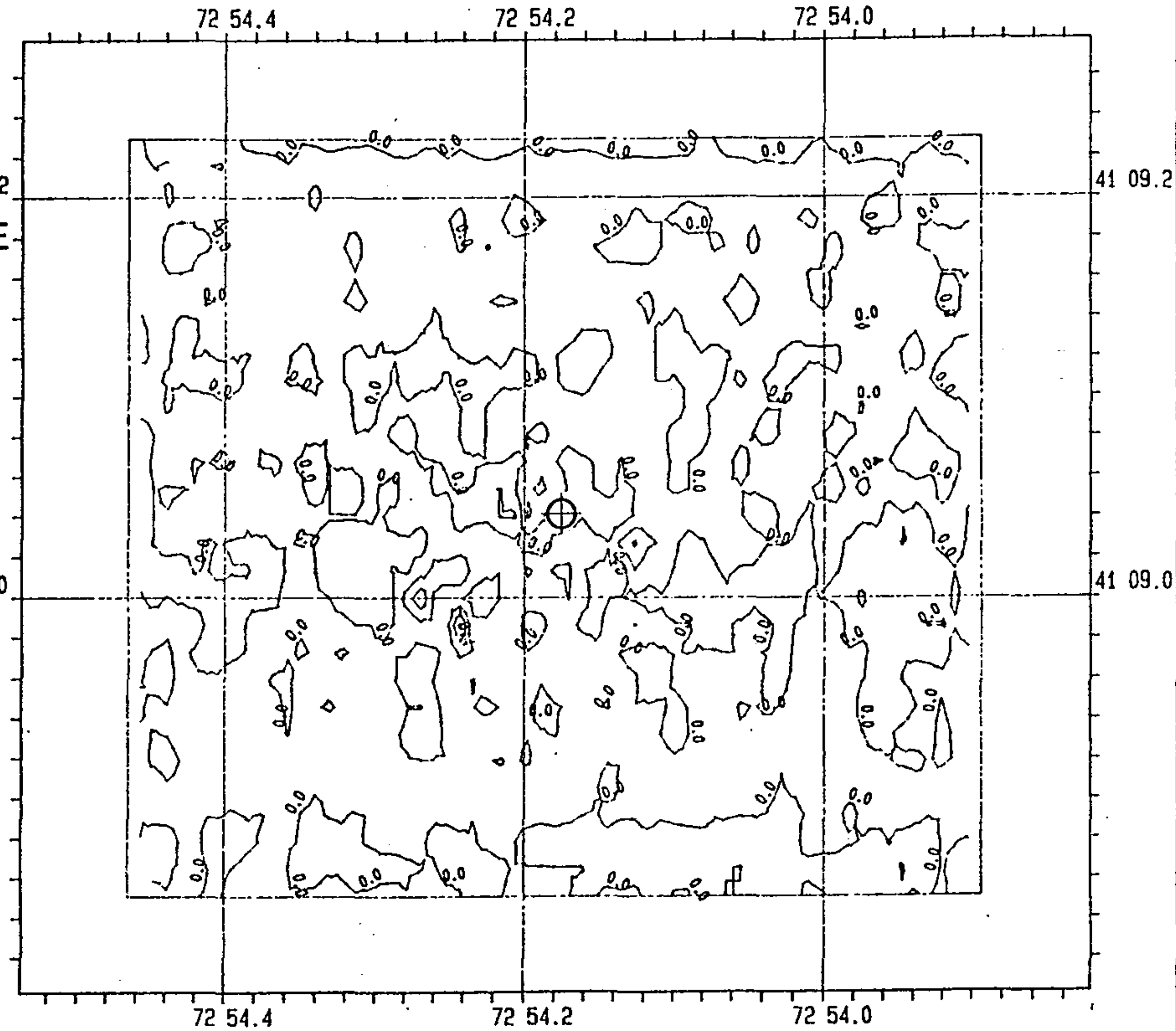
0 80 160

SCALE (m)



VOLUME DIFFERENCE
CAP SITE #1
POST-DISPOSAL
JUNE-AUGUST, 1983

Figure II-2-17



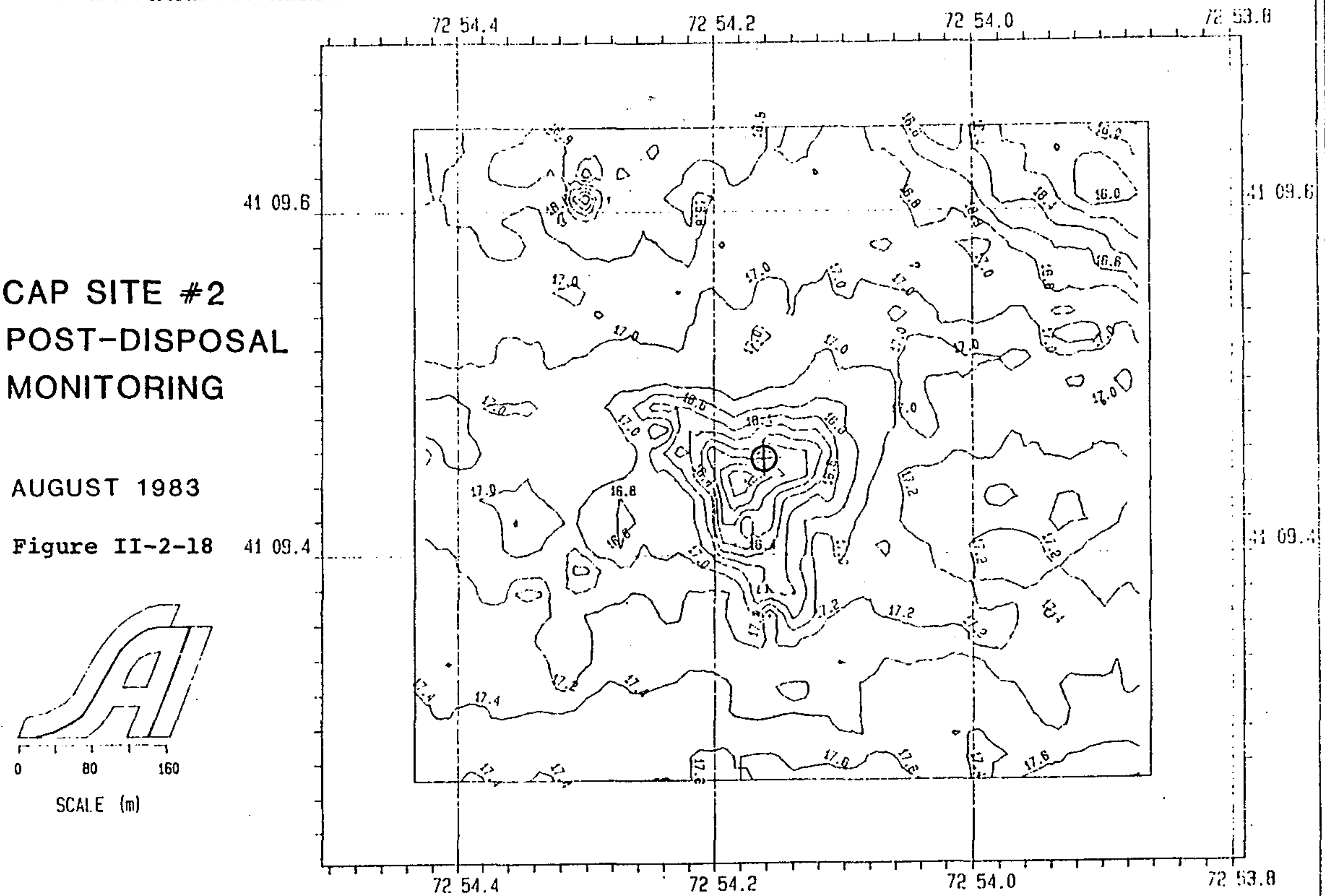
0 80 160

SCALE (m)

CAP SITE #2 POST-DISPOSAL MONITORING

AUGUST 1983

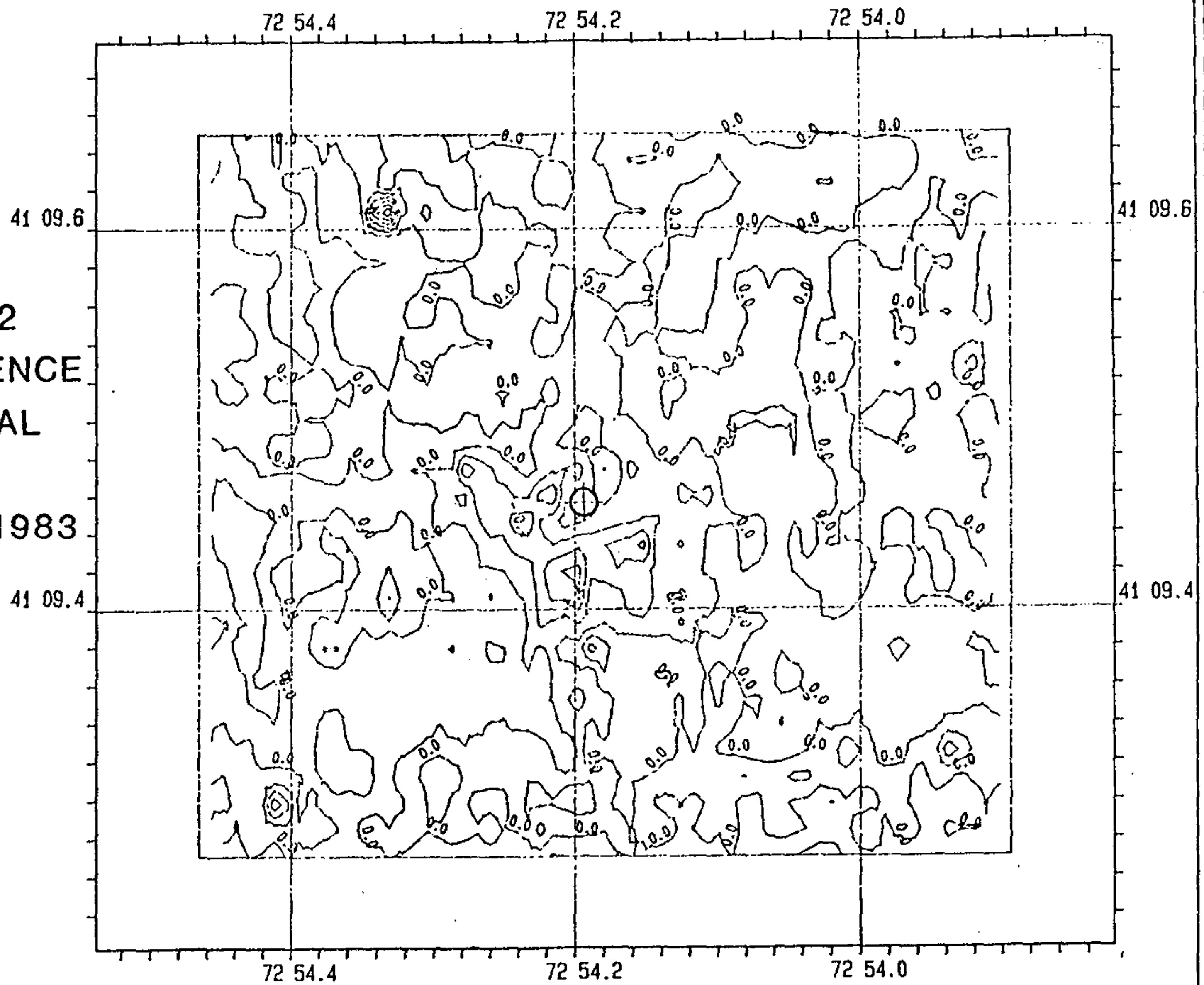
Figure II-2-18



CAP SITE #2
VOLUME DIFFERENCE
POST-DISPOSAL

JUNE-AUGUST, 1983

Figure II-2-19



0 80 160

SCALE (m)

chunks of wood to 0.5m long and derelict fishing gear and rope. No erosion/compaction stakes were found on the site, and therefore, measurements could not be made at this time.

2.5.3 REMOTS Observations at CS#1 and CS#2

On 29 and 30 August 1983, 22 stations at Cap Site #1 and #2 were sampled with three replicate photographs at each station.

In the two months following disposal, both cap site areas were significantly improved in benthic habitat quality. Figure II-2-20 compares values at each station for depth of the redox potential discontinuity (RPD) and Figure II-2-21 compares habitat indices for both sites between June and August 1983.

Frequency distributions of mean RPD depth and habitat index values for both sites in August indicate that both RPD depth and habitat indices are one class interval greater at Cap Site #1 than at Cap Site #2, suggesting that most of the area of Cap Site #1 has been bioturbated to a depth of 3-3.5cm. Most stations at Cap Site #2 are not reworked to as great a depth below the sediment-water interface. This may be related to the physical resistance that the comparatively larger sand grains offer to bioturbating organisms, as well as qualitative differences in colonizing species. Comparing these values with values obtained in June, the rate of increase in the depth of the RPD is approximately one centimeter per month. This is within the expected range of reworking rates for Long Island Sound benthos, given the high water temperatures and correspondingly increased metabolic activity of the infauna during the summer months.

By combining the volume difference results with the REMOTS observations, it is possible to assess the effectiveness of the sand cap in isolating Black Rock material from the colonizing benthos. Because the maximum depth of the RPD at Cap Site #2 is about 3cm, the area of the sand cap greater than 4cm thick can be considered as having effectively isolated the underlying material from the infauna. This represents about 20% of the total area covered by sand at Cap Site #2. A portion of the remaining 80% of the sand cap has areas where the depth of the RPD exceeds the thickness of the sand layer. By overlaying and digitizing the two contour maps of sand cap thickness and RPD depth, it is possible to determine the area of bottom where the infauna have penetrated the sand cap and are exposed to the underlying sediment. Figure II-2-22 shows the two contour maps for sand cap thickness and RPD depth at Cap Site #2, as well as a map delimiting the areas where the RPD depth exceeds the thickness of the sand cap. This area represents approximately 31% of the total area of the sand cap at Cap Site #2, which has been penetrated by colonizing organisms. However, it is important to note that the thickness of Black Rock material in these areas is quite small, generally less than 2 cm.

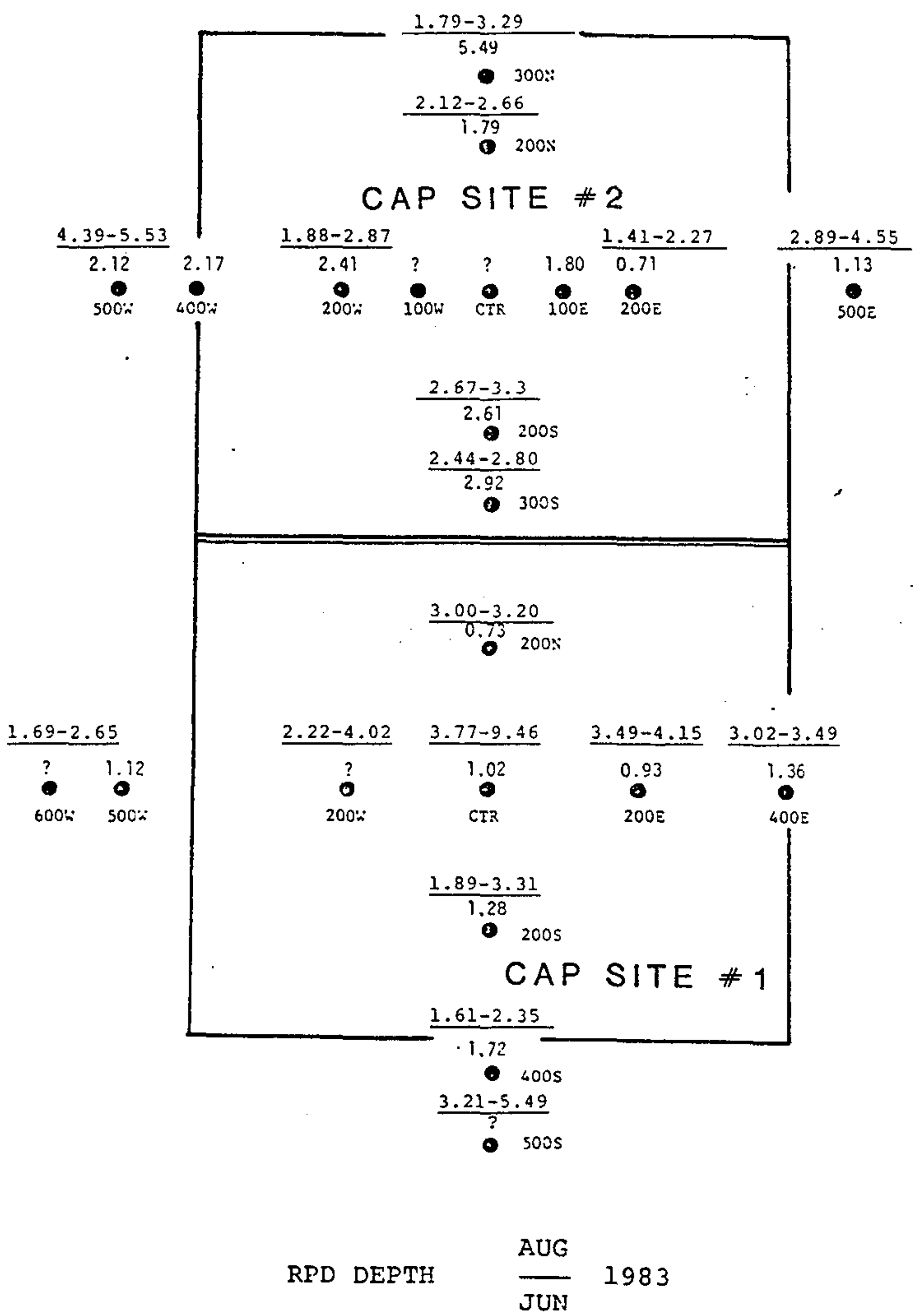
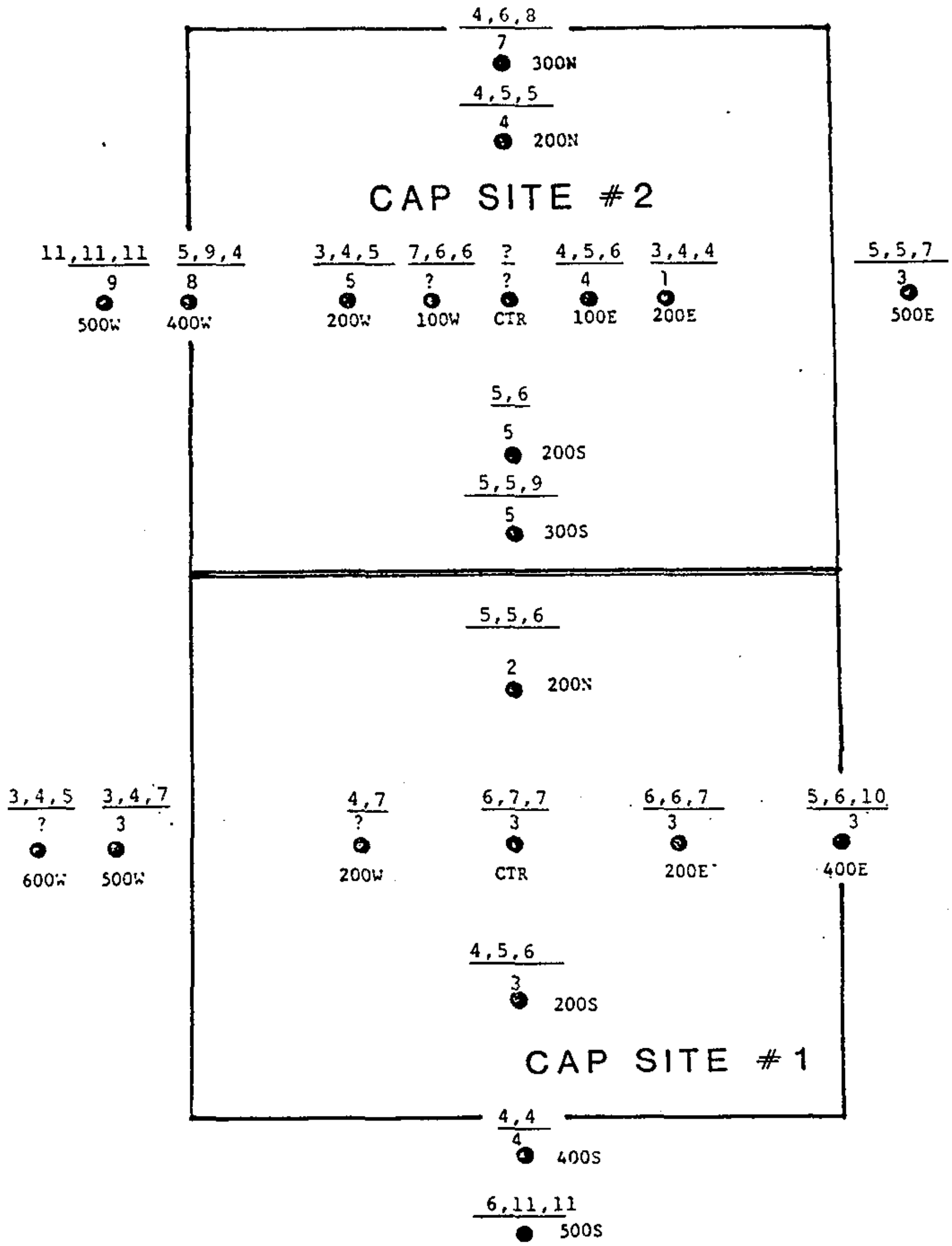


Figure II-2-20. RPD depths for August/June 1983.



HABITAT INDEX - $\frac{\text{AUG}}{\text{JUN}}$ 1983

Figure II-2-21. Habitat indices for August/June 1983

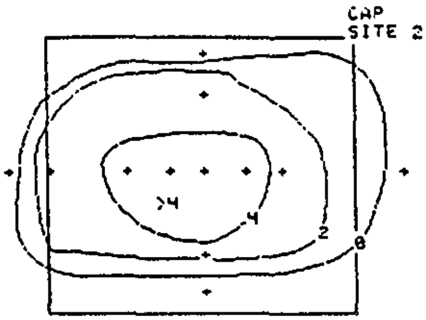


Figure II-2-22a
Contour map of sand cap thickness.

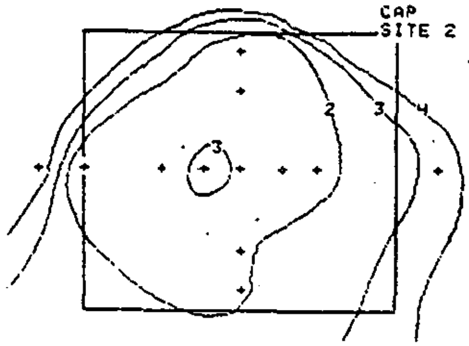


Figure II-2-22b
Contour map of RPD Depth.

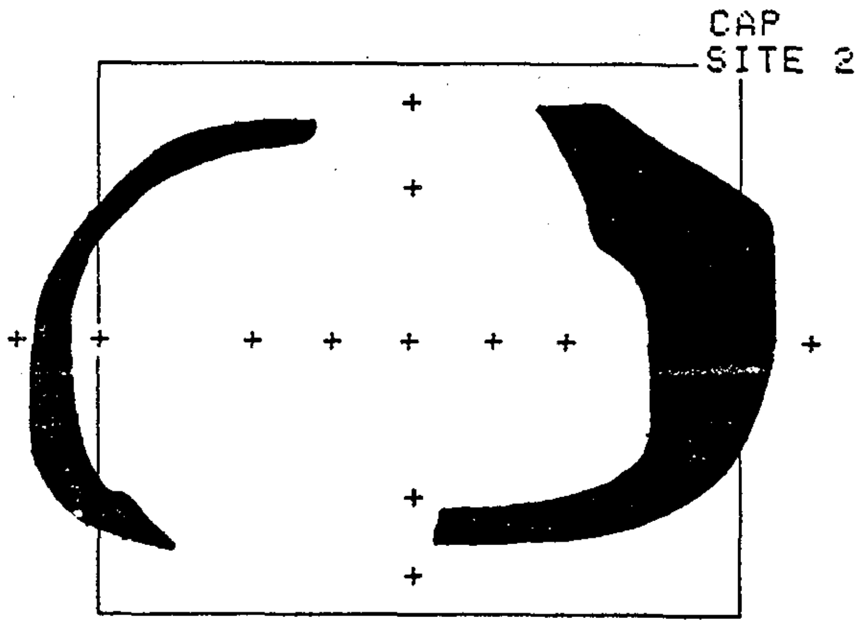


Figure II-2-22c
Shaded area indicates areas where infauna have penetrated sand cap and are exposed to the underlying Black Rock Material.

2.6 Summary

The capping operations at the CLIS disposal site was not completely successful in that the New Haven material was not adequately spread over the Black Rock sediment. Most of the dredged material behaved in a manner that would be expected based on the results of the previous Stamford/New Haven operations, however, the need for careful control and monitoring of disposal operations was certainly emphasized as a result of this study. Further disposal operations at CLIS will be controlled using the taut-wire moored buoy to cover Black Rock material on the eastern margin of Cap Site #1. Once the mounds were in place, post-disposal monitoring indicated no significant changes in sediment stability during the following summer months. The next sections of the report will discuss longer-term monitoring and response of the capped mounds to the environment at the CLIS site.

3.0 NEW HAVEN 1983 DISPOSAL SITE

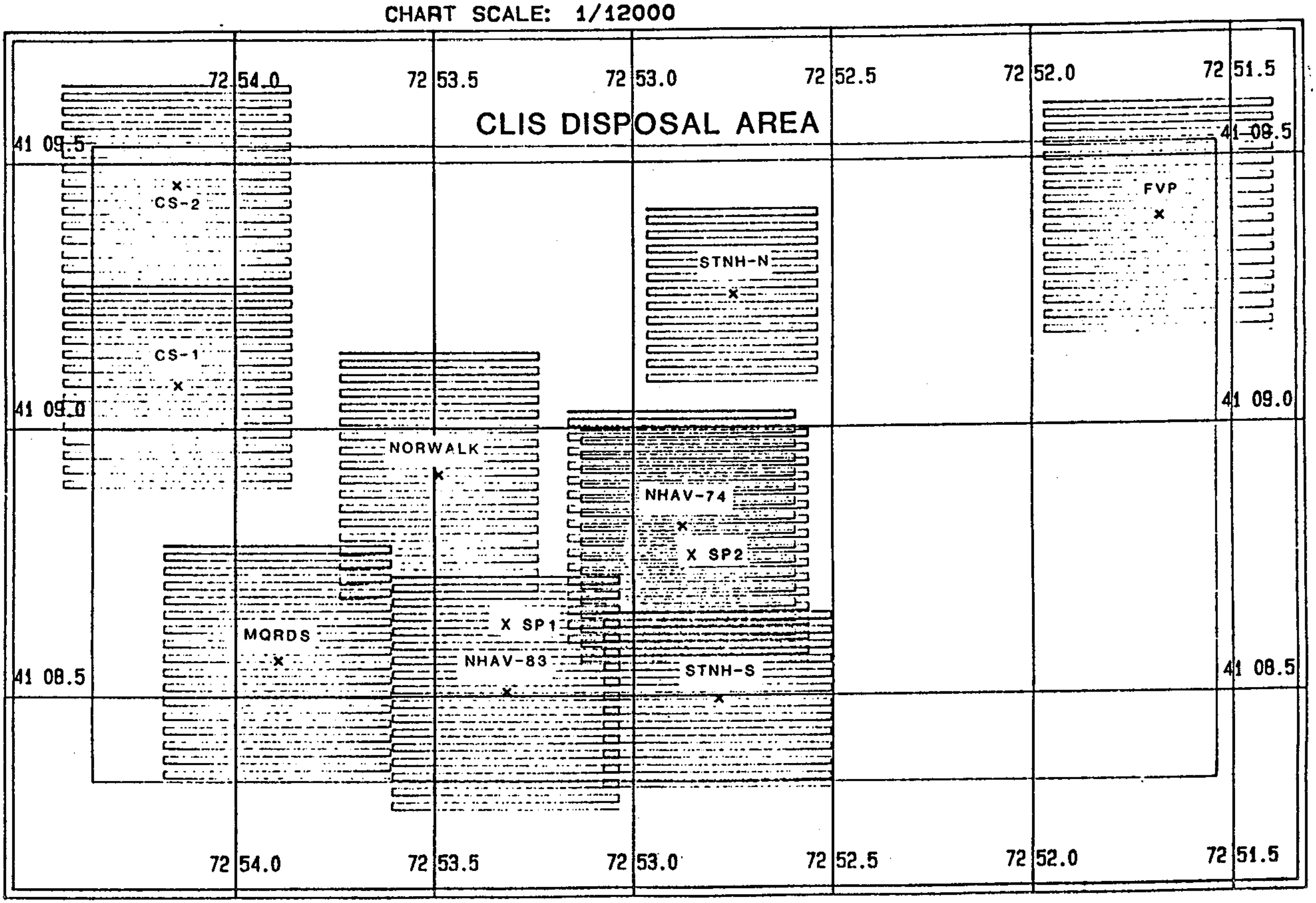
3.1 Introduction

On 18 October 1983, Science Applications International Corporation (SAIC) initiated a cruise to the Central Long Island Sound (CLIS) disposal area in order to assess the baseline conditions existing at the proposed New Haven 1983 (NHAV-83) disposal site. Located at the southern boundary of the CLIS disposal area, this site is defined by a taut-wire moored disposal buoy located at 41 08.51656'N, 72 53.3075'W. Work accomplished on this cruise conformed to the standard Disposal Area Monitoring System (DAMOS) baseline sampling regimen. This consisted of a precision bathymetric survey, sediment sampling for both physical and chemical analysis, REMOTS profiling and various diving operations.

3.2 Bathymetry

The NHAV-83 disposal site is located approximately 750 meters south of the Norwalk disposal site in the CLIS disposal area (Figure II-3-1). Figure II-3-2 depicts the depth contour chart generated from the bathymetric survey performed on 22 October. As can be clearly seen, the bottom is relatively flat and slopes gradually from a depth of approximately 21 meters in the north to about 22.5 meters towards the south. A portion of the disposal mound formed from disposal of permit material at the original site of the "SP" buoy (SP#1) is clearly evident in the northern area of this site. This is also shown in the depth profiles of the northernmost 12 lanes of the survey (Fig. II-3-3). Dredged material was present in the sediment samples taken approximately 125 meters north of the center of the NHAV-83 survey area (Table II-3-1). It appears that this disposal site will fit nicely into the future plan to construct a containment area composed of disposed material at CLIS and will fill in the area located between the Norwalk and Stamford-New Haven South disposal sites.

Figure II-3-1. Central Long Island Sound Disposal Area (CLIS)



NEW HAVEN 1983

BASELINE

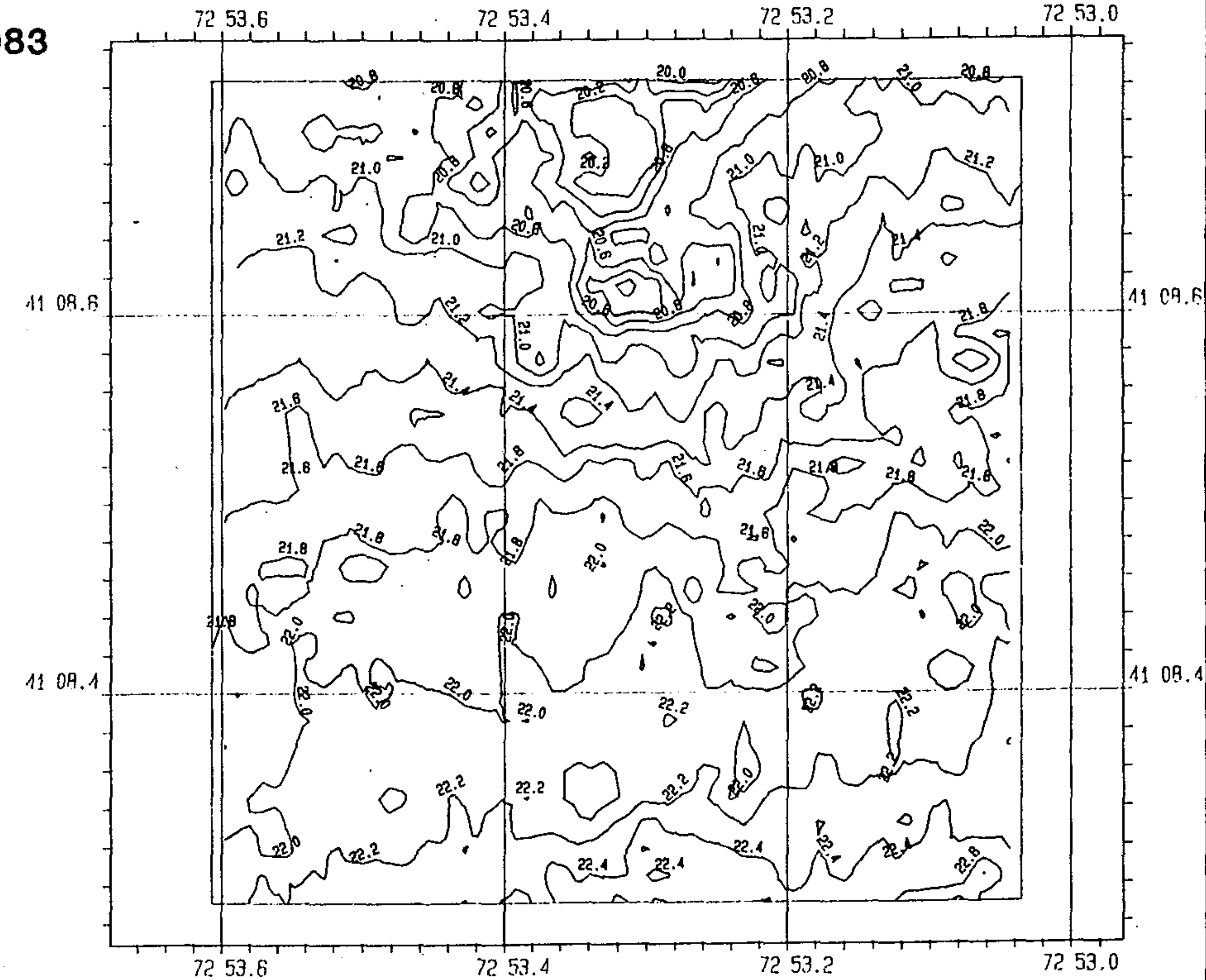
22 OCTOBER 1983

INTERVAL: 0.2m

SCALE: 1/4000

DATUM: MLW

Figure II-3-2



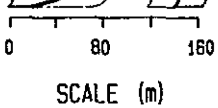


Figure II-3-3. NHAV 83 October 1983 Profile Plots.

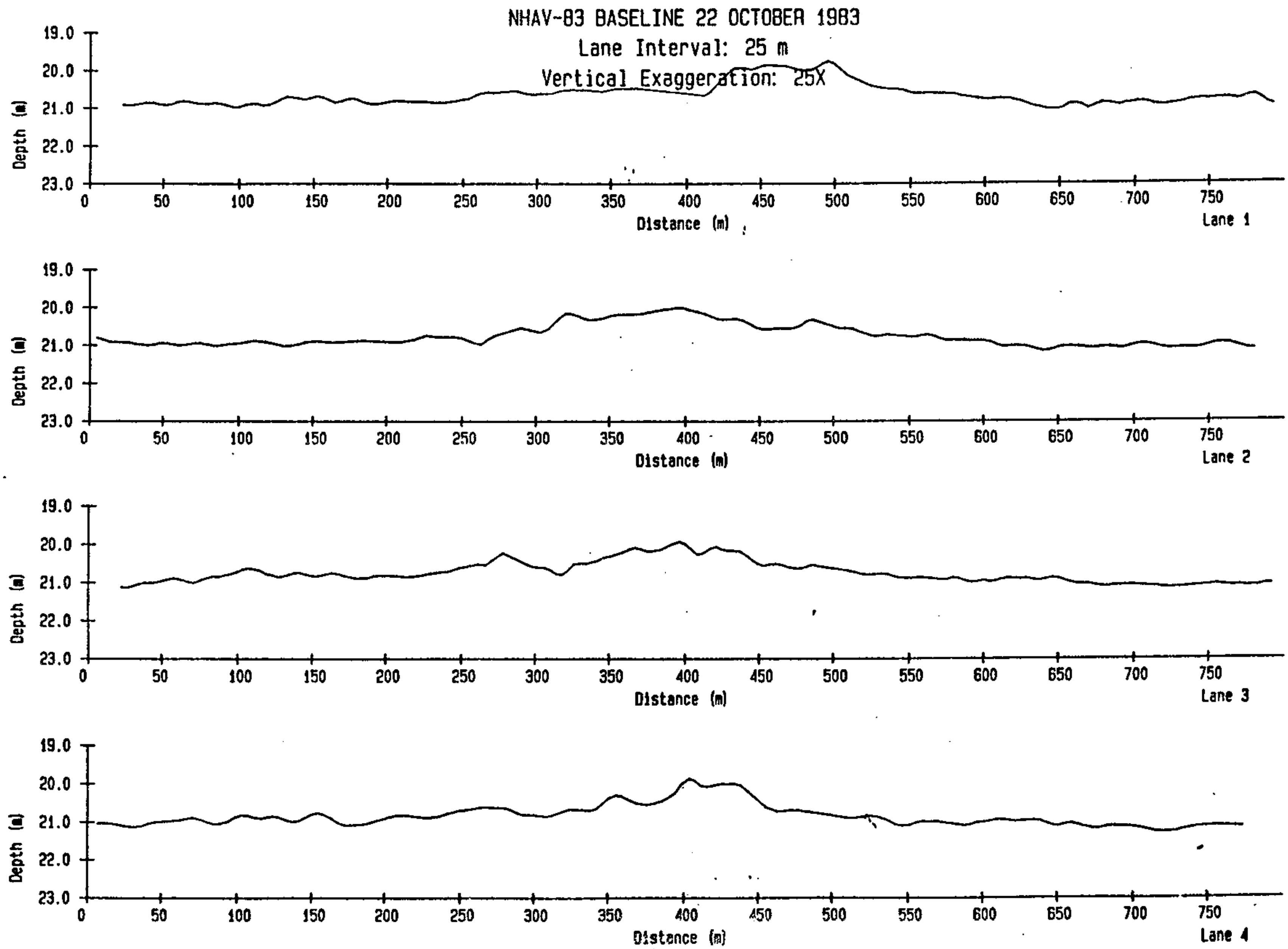


Figure II-3-3 (cont)

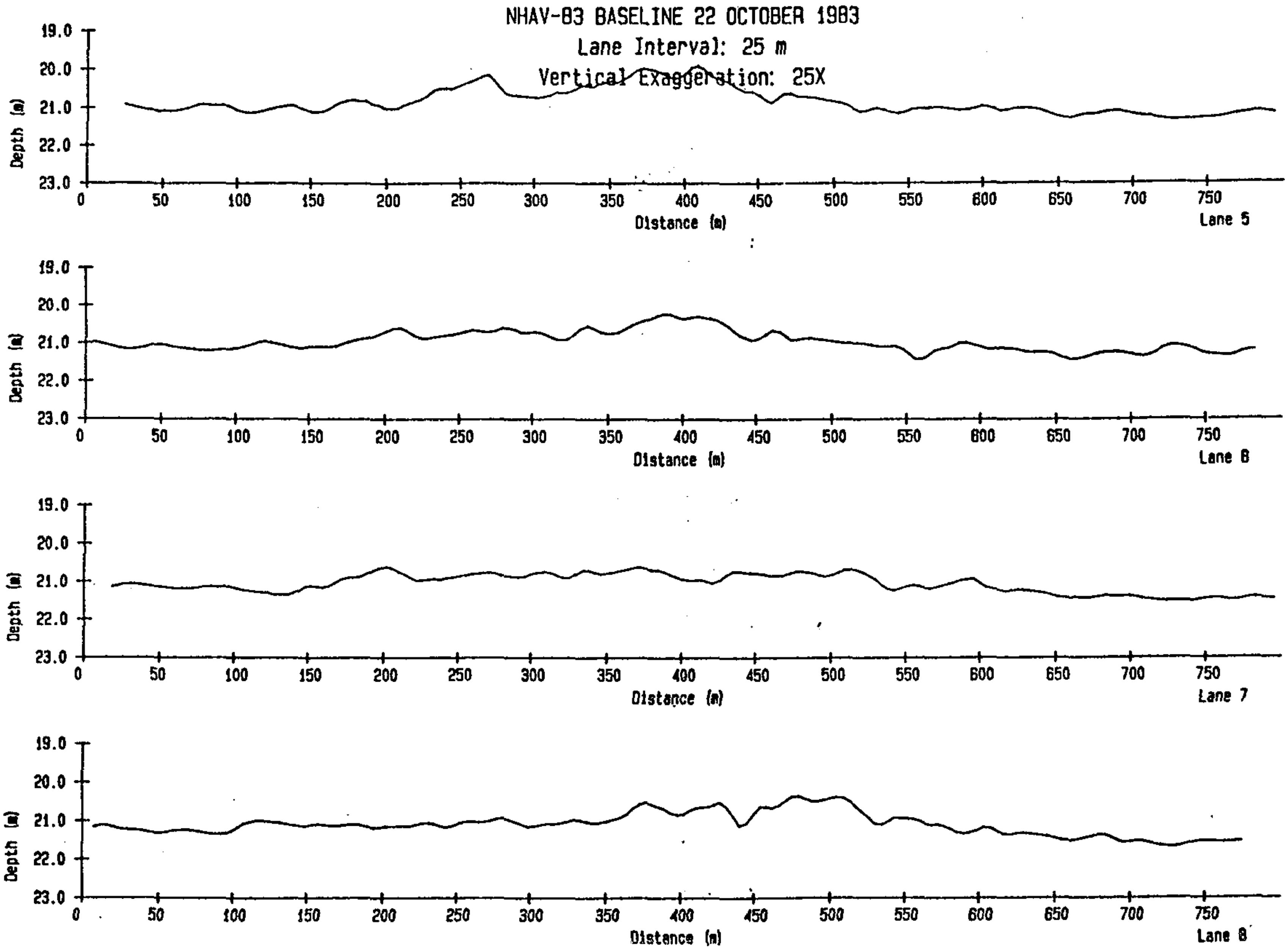
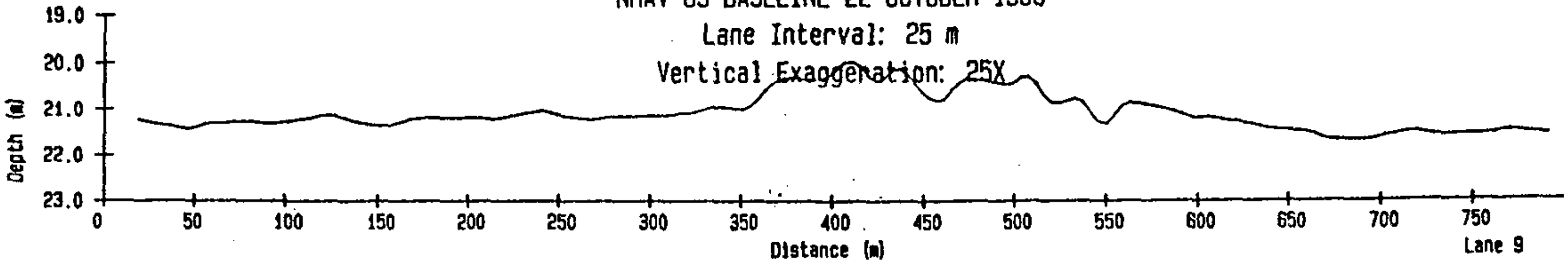
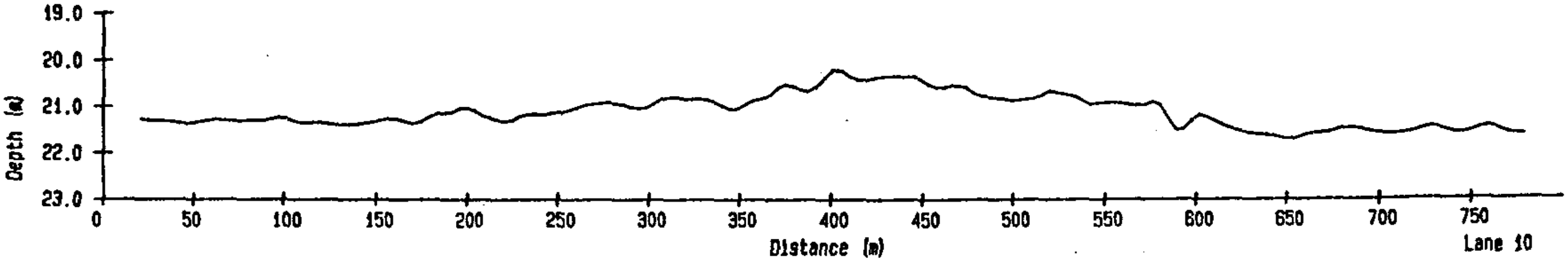
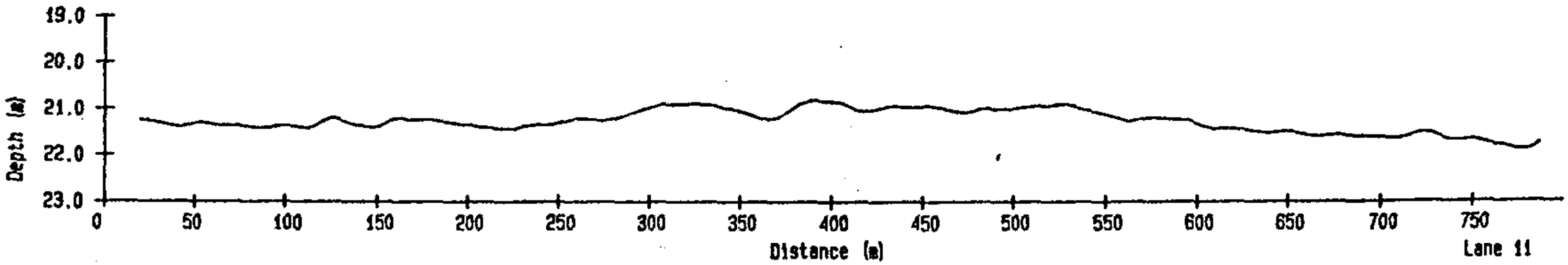


Figure II-3-3 (cont)

NHAV-83 BASELINE 22 OCTOBER 1983
Lane Interval: 25 m
Vertical Exaggeration: 25X







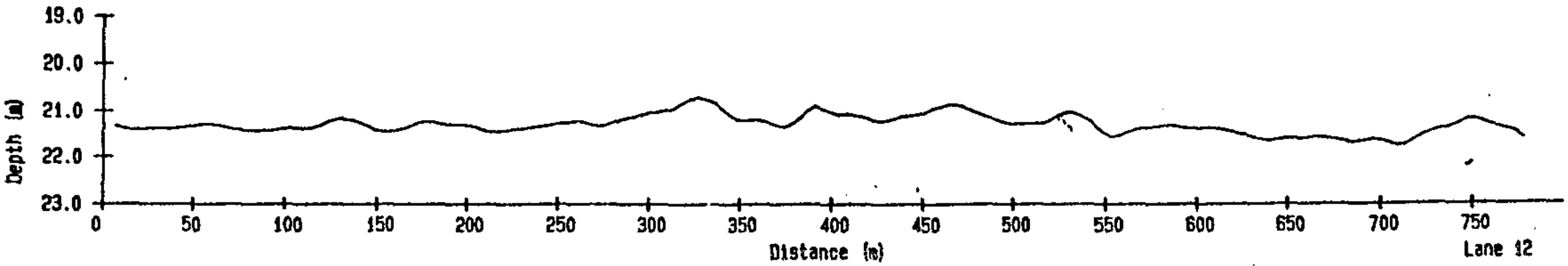


Table II-3-1

Sediment Sample Visual Classification

STATION	OBSERVATIONS
200 North	Thin oxydized layer over 5cm sandy cohesive sediment over black dredged material ("SP" material)
100 North	Thin oxydized layer over gray, sandy silt with numerous clay modules
Center	1.5 cm oxydized layer over black sandy silt with some shell hash and slight sulphide odor
100 South	2 cm oxydized layer over cohesive black organic silt. Some sulphide odor and tube worms
200 South	1 cm oxydized layer over black sandy silt. Well colonized by tube worms and amphipods
200 East	Thin sandy layer over dark gray sandy sediment with low water content
100 East	1 cm oxydized layer over grayish cohesive sediment
100 West	Thin oxydized layer over dark gray gelatinous matrix
200 West	Natural bottom consistency of a thin, fine oxydized layer over gray, sandy silt

Disposal operations at the NHAV-83 disposal site commenced during the early morning hours of 27 October and at 0900 on that day, the survey team was present at the disposal site as the second scow load of material was deposited. During this operation, the survey vessel remained as close as possible astern of the scow and the resulting disposal plume was tracked using a survey fathometer operating at 208 kHz. Loran-C fixes were taken every 30 seconds as the survey vessel followed the tug and scow past the disposal point and turned back towards New Haven. Figure II-3-4 depicts the actual track of the survey vessel during this operation, and shows the points where the disposal plume was acquired and lost by the fathometer. Figure II-3-5 represents the actual echogram recorded and shows quite clearly the dense plume generated upon disposal. Between fix #4 and fix #5, the plume was sufficiently dense so as to blind the fathometer and completely obscure the bottom trace. As shown in Figure II-3-4, the disposal plume appears to be a short-lived event, and any substantial dispersion of dredged material with similar lithology seems unlikely. Diving operations on this site occuring approximately 3/4 hours post disposal showed a slight degradation in visibility on the bottom due to suspended particulate matter in the water column. On a subsequent dive 2 hours after disposal, the water had returned to its usual predisposal clarity.

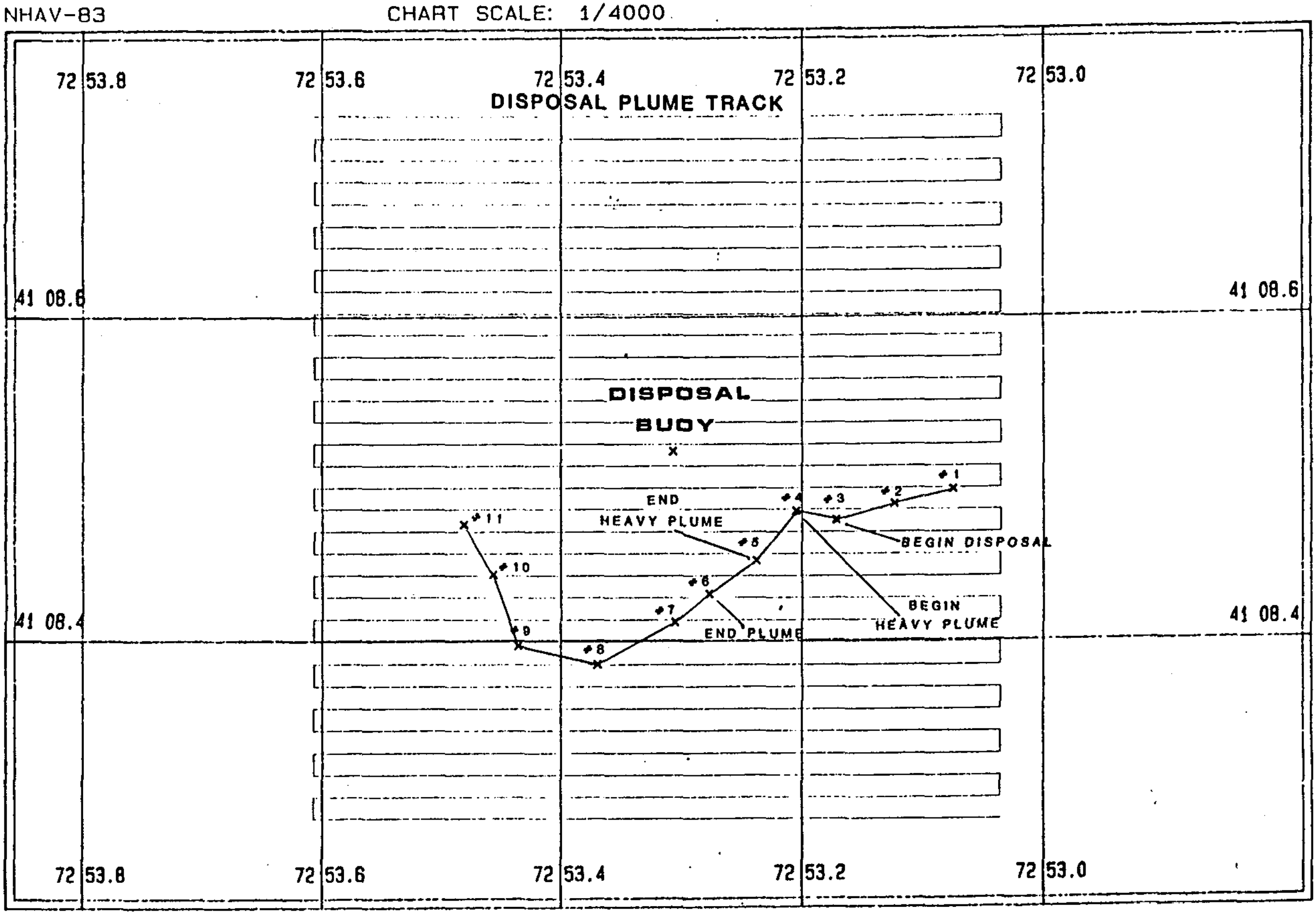
It is readily apparent from Figure II-3-4 that the disposal did not take place close to the taut wire disposal buoy. Subsequent discussions with Corps personnel emphasized the importance of such "point dumping" and initial indications are that later disposal was significantly closer.

The bathymetric survey conducted on 20 December 1983 confirms the lack of controlled point dumping at NHAV-83 (Fig. II-3-6). An irregularly shaped mound, approximately 1.5 m in elevation and 300 m in diameter occurs at the buoy. However, additional material approximately 20-40 cm thick trails from the center mound to the northeast. This material could result from inaccurate point dumping or premature commencement of disposal operations.

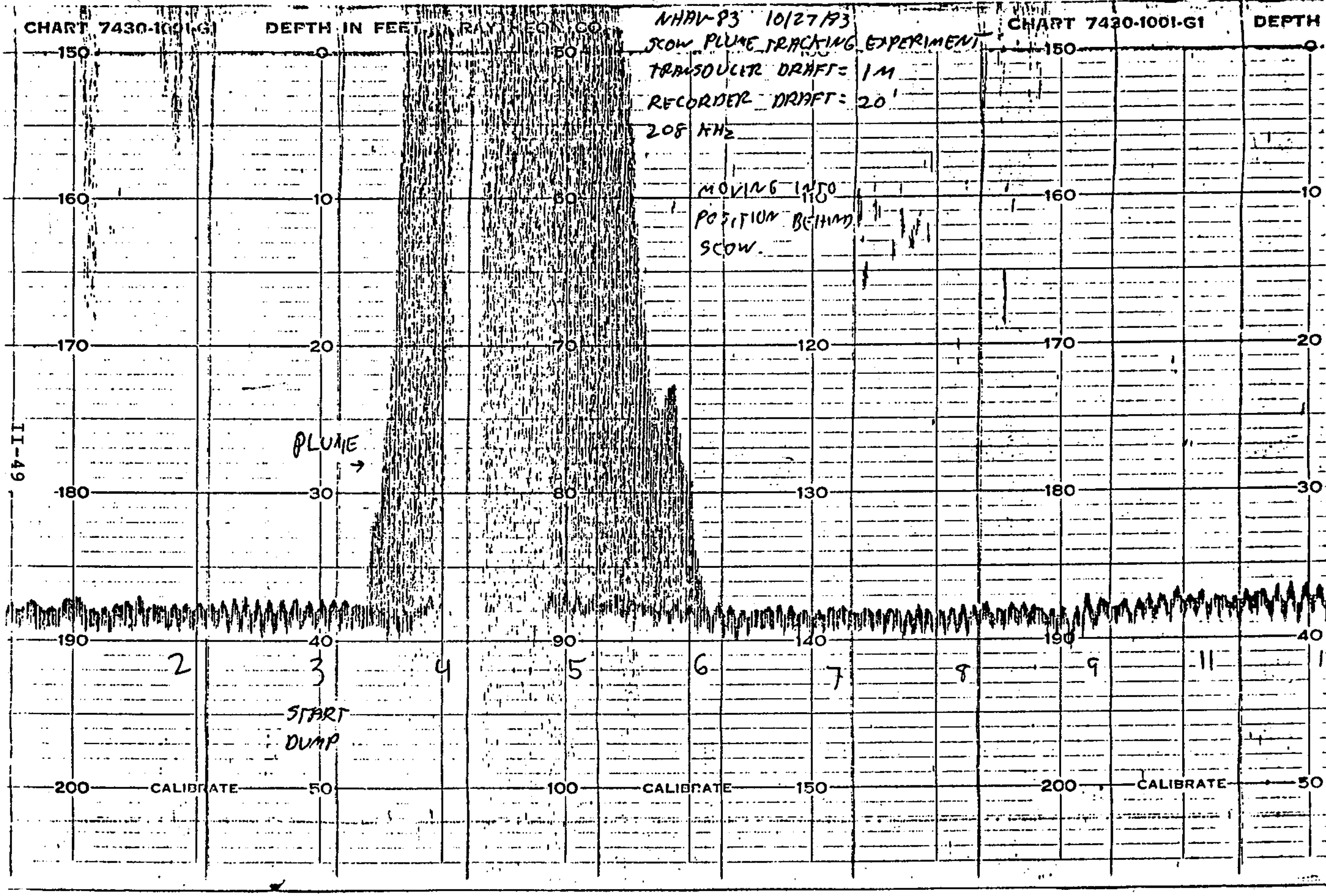
3.3 Sediment Sampling

Three replicate sediment samples were taken at each of nine stations located at the center, 100 meters and 200 meters in each cardinal direction from the center of the disposal site. In addition, three replicates were obtained at the CLIS reference site located at 41 07.948N, 72 52.735W. The first sample taken at each station was sub-sampled for sediment chemistry and for grain size analysis. Subsequent samples at each station were sub-sampled for sediment chemistry only. All samples were labeled and stored on ice until picked up by NED personnel on 4 November. Figure II-3-7 depicts graphically the nine stations of the sediment sampling regime used at this site and Table II-3-1 details a visual description of the sediment obtained at each station. The bottom appears to be composed of essentially natural sediment within a 200 meter square area centered about

Figure II-3-4. Ship's track showing limits of disposal plume.



Fi II-3-5. Echogram showing disposal pl



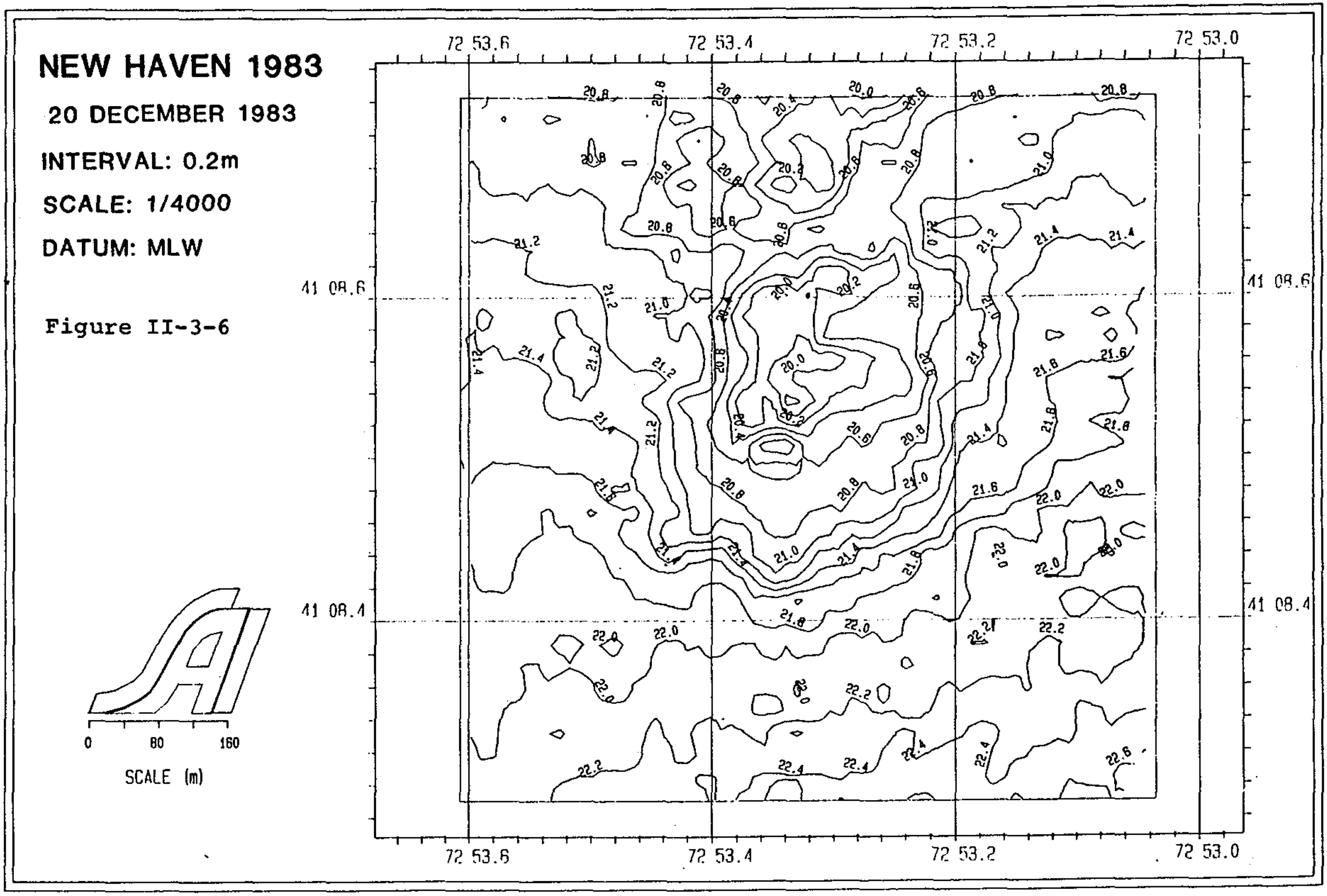
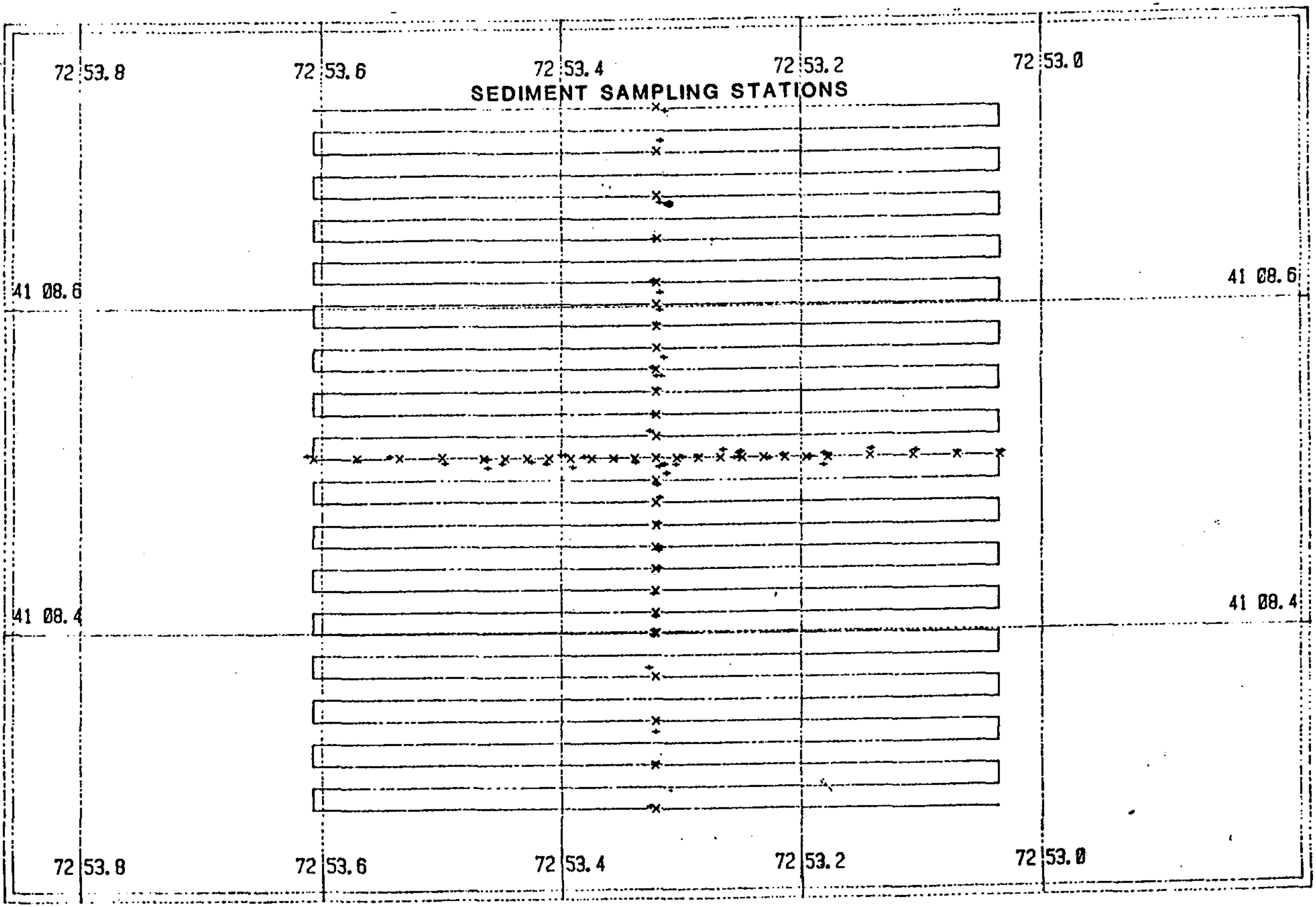

NEW HAVEN 1983
20 DECEMBER 1983
INTERVAL: 0.2m
SCALE: 1/4000
DATUM: MLW
72 53.6
72 53.4
72 53.2
72 53.0
41 08.6
41 08.4
0
80
160
SCALE (m)

Figure II-3-6

Figure II-3-7. Sediment sampling stations, NHAV 83.



he disposal buoy. Samples were taken, but not retained for analysis, out to a distance of approximately 350 meters and showed that the natural sediment extended out to these boundaries with two notable exceptions. As previously stated, dredged material from the "SP" disposal site was found to incur into the NHAV-83 site to within a point 125 meters north of center. In addition, the presence of a 2 cm layer of black organic silt in samples taken 350 meters east of center may be associated with the Stamford-New Haven silt capping experiment. These incursions may make it difficult to ascertain the boundaries of the NHAV-83 disposal mound in future sampling cruises.

3.4 REMOTS

The NHAV-83 disposal site was surveyed by Marine Surveys Inc. of New Haven, CT utilizing the REMOTS profiling/imaging system. Figure II-3-8 shows the locations of the station sampled prior to disposal. Three photographs were taken at each of these stations as well as the CLIS reference site.

Table II-3-2 lists the stations occupied during the pre- and post-disposal surveys. For the pre-disposal survey, the major modal grain-size for all stations except 200E is 4ϕ (silt to clay). All three replicates of 200E show significant additions of 3ϕ (very fine sand) and 2ϕ (fine sand) in the upper to 3 cm of this predominantly silty-clay bottom. This sandy surface layer also includes detrital shell in the 1 to -10 size range as well as cobbles up to 4 cm in diameter. One replicate of station 400W, a silty-clay bottom, also has a surficial layer of detrital shell material and coarse lithic materials.

After disposal operations, the major modal grain-size for all stations is still 4ϕ. Station 400N also contains admixtures of fine (3 to 2ϕ) and medium (2 to 1ϕ) sand. Station 600S/W shows the presence of a three centimeter diameter fragment which is covered with barnacles. Coarse shell material (0 to -1ϕ) is concentrated at the sediment surface. These types of particles are interpreted to represent dredged material. Station 400S/E shows significant admixture of fine sand (3 to 2ϕ) to this otherwise silt-clay bottom.

Most values of small-scale boundary roughness fall within the frequency class 0.41 to 0.80 cm with subordinant modes at 0.0 to 0.40 cm and 0.81 to 1.20 cm (Fig. II-3-9). This low degree of boundary roughness is typical of the ambient seafloor unaffected by dredged material and is also characteristic of fine-grained dredged material which have been deposited as a turbid slurry. No difference is detected between the frequency distribution of the pre-disposal baseline survey and this post-disposal survey.

The proximity of the NHAV-83 site to the Norwalk and MQR disposal sites, located respectively to the north and west of the center of NHAV-83 (Fig. II-3-1), has resulted in the northern and western edges of the NHAV-83 site being located on

Table II -3-2. Station coordinants for 33 pre- and post-disposal REMOTS monitoring stations. Asterisks identify predisposal stations (n=17). Station replicate numbers follow each station in parentheses. Stations with no values had three replicates taken.

100N*	300N(1)	250N(1)	200N*
100N*	CTR*	100S*	200S*
300S(1)	400S*	400E*	200E*
100E*	100W*(2)	200W*	400W*
500W(1)	600W	700W(1)	800W(1)
600N/W(1)	500N/W(1)	400N/W*	500N/E(1)
400N/E*	200S/E(1)	300S/E(2)	400S/E*
400S/W*	500S/W(1)	600S/W(1)	250S(1)
CLIS-REF*			

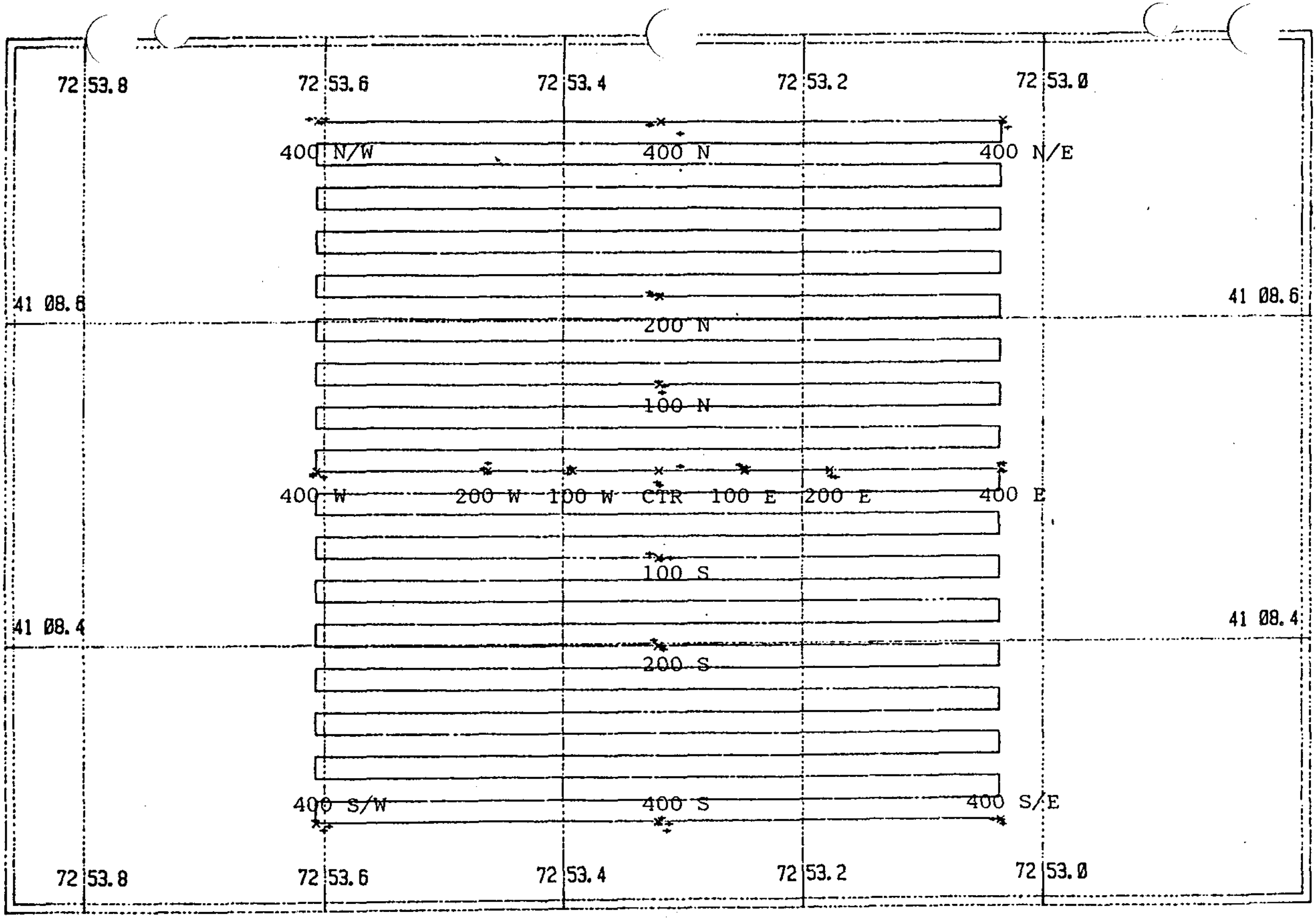


Figure II-3-8. Location of New Haven-83 stations and positions at which REMOTS replicates were taken. X = station, + = position at which individual replicate was taken.

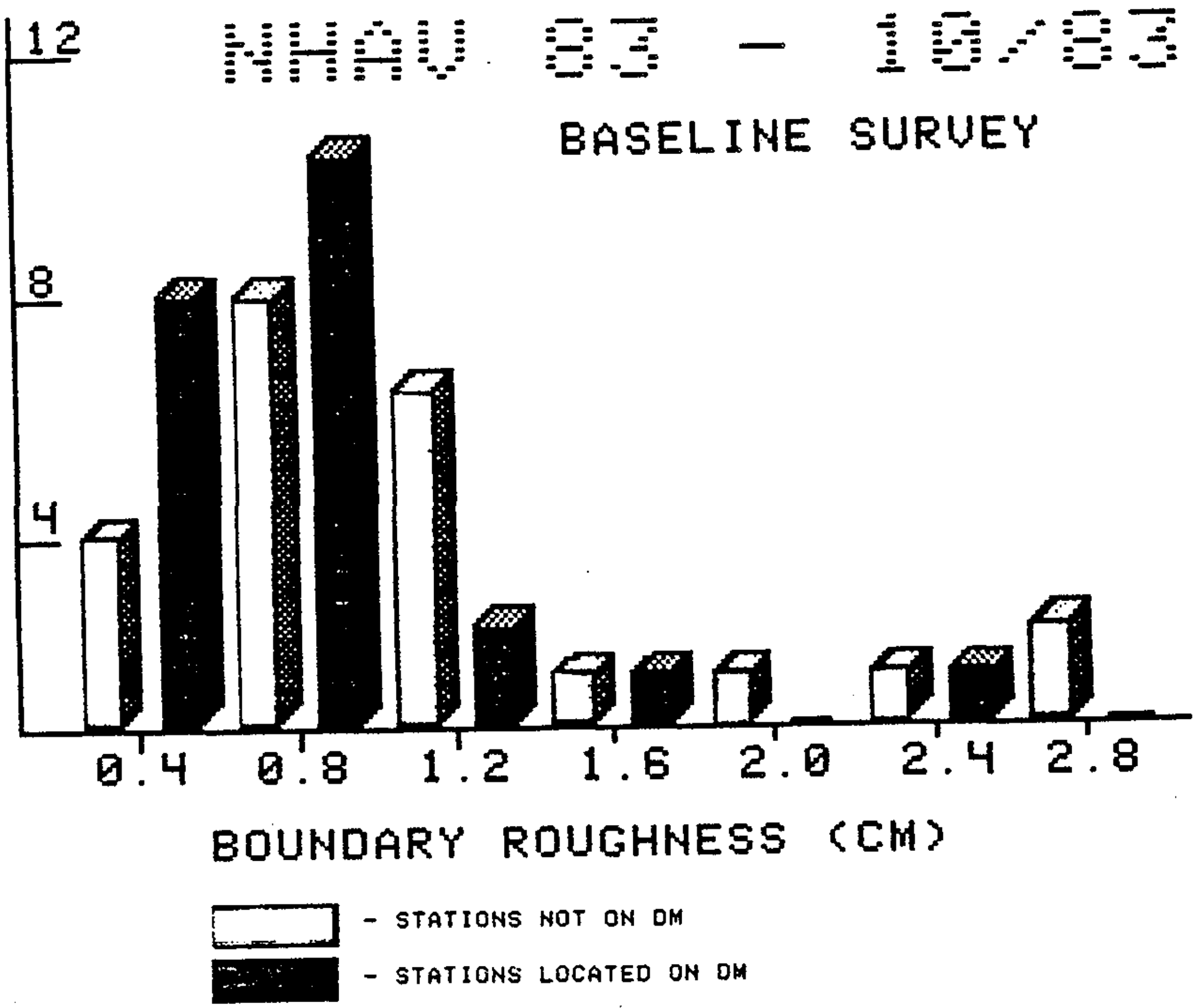


Figure II-3-9. Frequency distribution of boundary roughness in all NHAV 83 stations, October 1983.

dredged material (Fig. II-3-10). The thicknesses of dredged material range from 2.5 cm to 11.0 cm at stations 100N, 200N, 400N, 100W, 200W, and 400W (Fig. II-3-11). The uniform distribution of dredged material in the northern and western quadrants of the study area together with the relative thinness of dredged material suggest that the NHAV-83 site is located on the flanks of one or both of the above mentioned disposal sites. Figure II-3-12 is an isopleth map of the thickness of dredged material after disposal. The thickness of dredged material is measured from sediment profile images by identifying the pre-disposal sedimentary surface as shown in Figure II-3-13. Because the height of the camera's optical prism is 16 cm, dredged material thicker than this depth cannot be measured by this technique. Precision bathymetry is used to measure dredged material which exceeds the REMOTS window height. Only two stations on the sampled grid show that the seafloor has not received dredged material (300S/E and 400S/E). Stations 700W, 800W, and 600S/W appear to lie outside of the area affected by this disposal operation but these stations lie on "older" material which is presumably related to their proximity to the MQR disposal site. The stations spacing in the NW, SW and NE quadrants and eastern and southern ends of the cross-shaped sampling grid do not allow accurate location of the dredged material isopleths in these regions. Similarly, data from the northern end of the grid (400N) do not allow contouring of this region because of uncertainties about what is fresh material and what might be pre-existing material related to the proximity of the Norwalk disposal site. Nevertheless, the bulk of the dredged material appears to be confined within the closed 6 cm isopleth, an area of 3.2×10^5 m^2.

The penetration depth of the REMOTS optical prism into the bottom is shown for the post-disposal survey in Figure I-3-14a. The data are bimodally distributed about the class 9.1 to 11.0 cm and 12.1 to 14.0 cm. The significance of this bimodality in terms of differences in geotechnical properties or disposal chronology is unknown. These modalities are all recorded from stations which lie on dredged material. The baseline survey (Fig. II-3-14b) showed that the modal penetration depth was 8.1 to 9.0 cm at stations which were not affected by earlier disposal operations, while affected stations had values falling into a 10.1 to 11.0 mode. These data support the contention that freshly deposited material are less compacted than older material which, in turn, are less compacted than the ambient seafloor. Repeated REMOTS surveys may allow one to characterize the relative age of fine-grained dredged material by their degree of compaction. This would be accomplished by following the rate of compaction over time.

The baseline survey (Fig. II-3-15) indicated that in October, the mean redox depth for stations located on pre-existing dredged material was 3 cm while those located on bottoms not affected by dredged material was 5 cm. The CLIS-REF station at this time had a redox depth of 4 cm. Figure II-3-16 shows that, for the January post-disposal survey, the area of the bottom where redox depths are >3 cm is equal to 7.7×10^5 m^2.

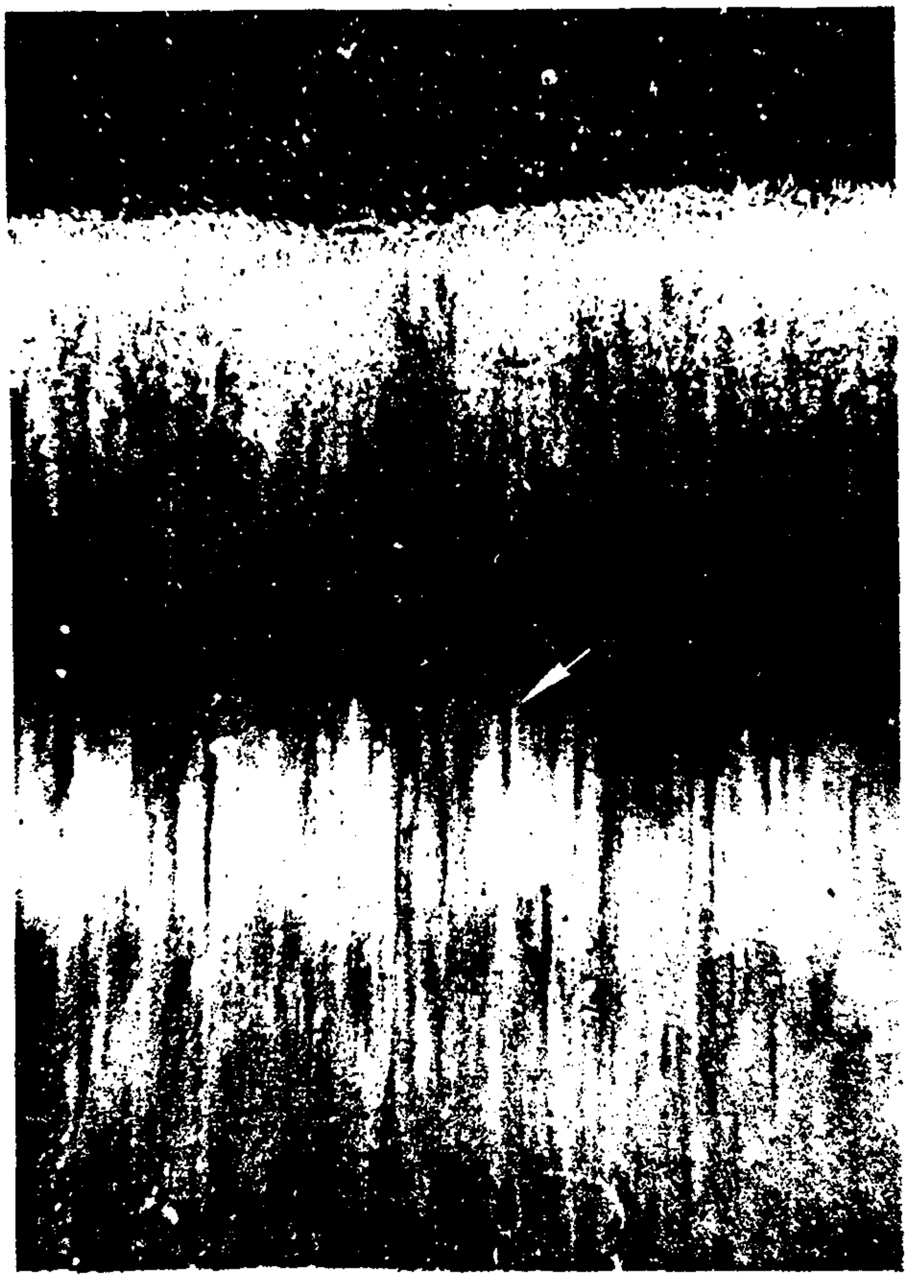


Figure II-3-10. Station 400 N/W showing a buried redox at a depth of ca. 6 cm (arrow), a thin redox (1.5 cm) near the sediment-water interface, and a Stage I polychaete assemblage. These criteria indicate that this bottom has receieved a 6 cm thick layer of dredged material in the recent past.

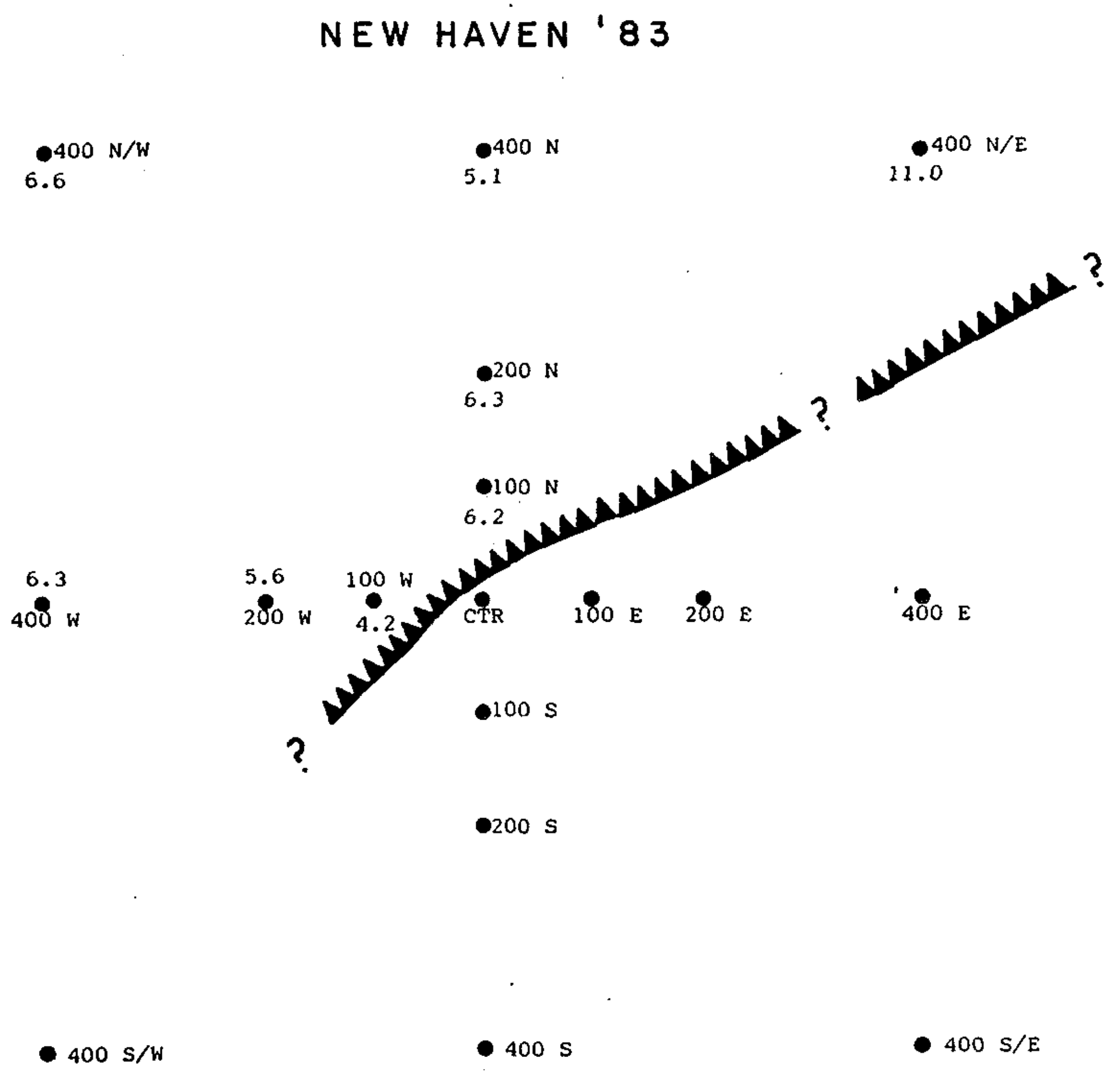


Figure II-3-11. Areal limits and thickness (cm) of disposed materials, October 1983. All stations to the north and west of the line show dredged material layers. Thickness of the material layer is the average of three replicates, except for those of stations 200W and 100W, where only one replicate showed a dredged material layer.

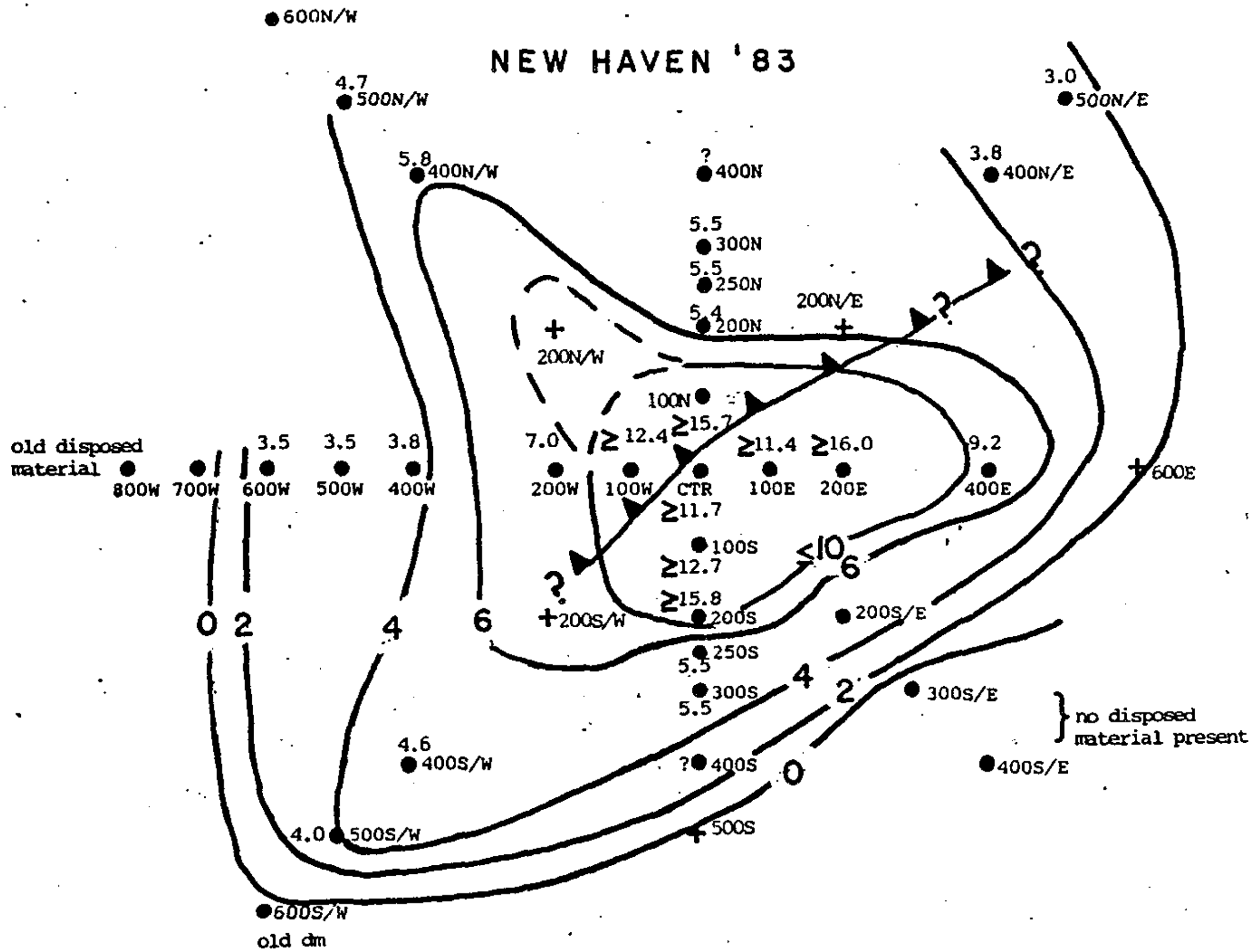


Figure II-3-12. Disposed materials thickness (isopleth) map, January 1984. The symbol ▲—▲ shows area in the northwest quadrant that contained disposed materials in the baseline survey. The contour values are in cm. Crosses mark five locations where stations need to be added to better define disposed material thickness.

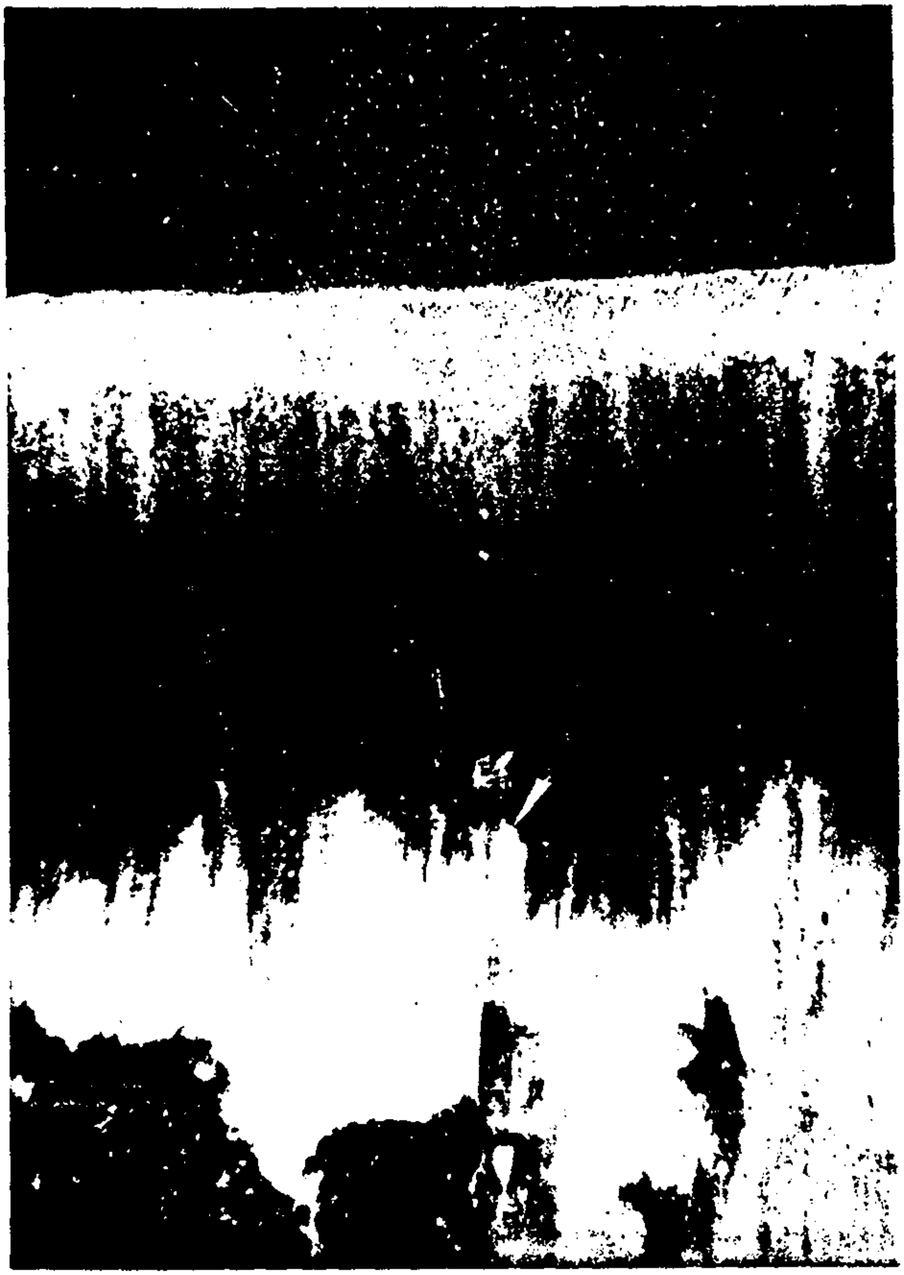


Figure II-3-13. Sediment-profile image of station 200N showing a 5 to 6 cm layer of disposed material lying above a buried redox boundary (arrow), which defines the predisposal surface. Scale 1.5X.

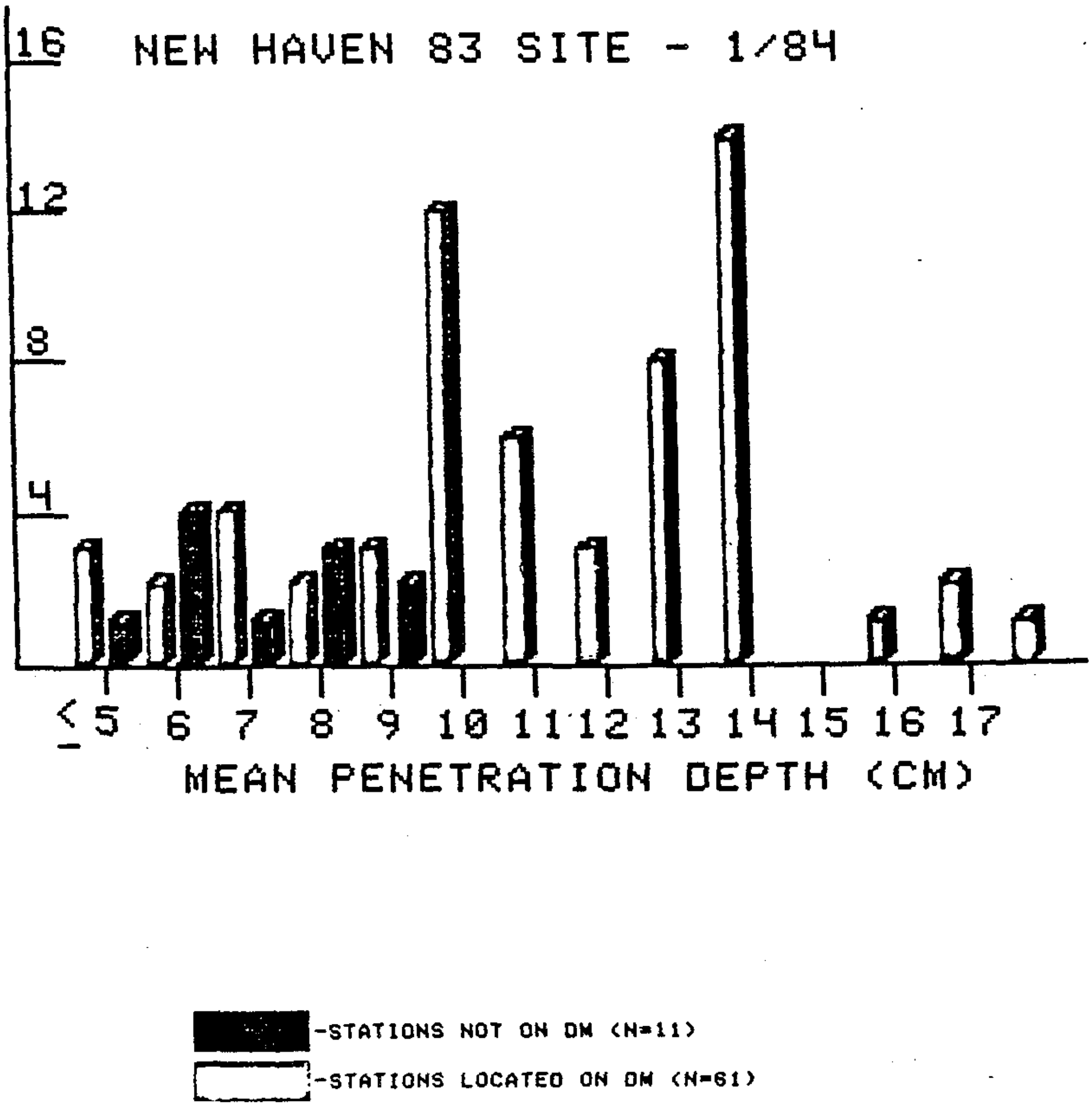


Figure II-3-14a. Frequency distribution of mean penetration depths, January 1984.

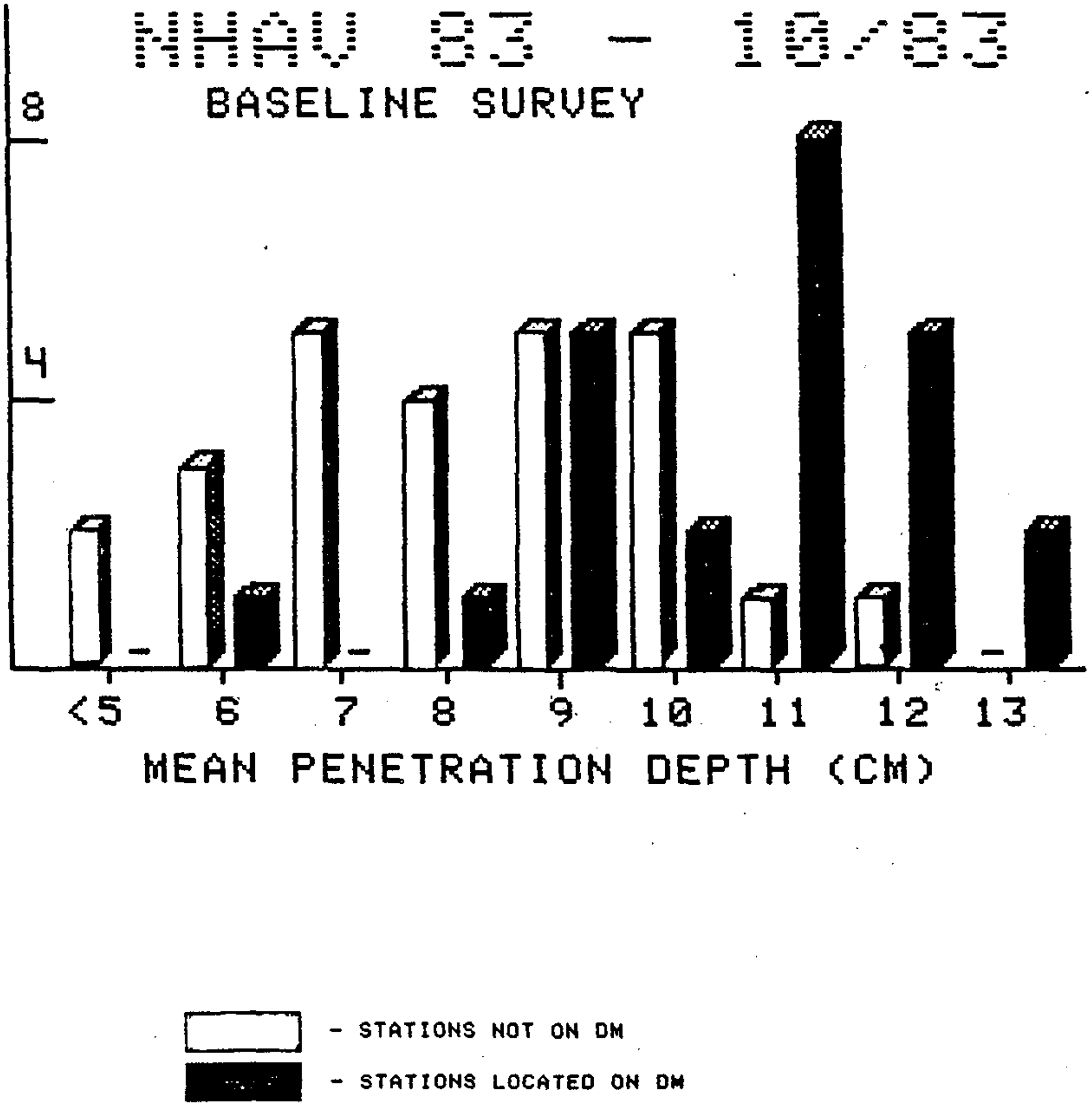


Figure II-3-14b. Frequency distribution of mean penetration depths, October 1983.

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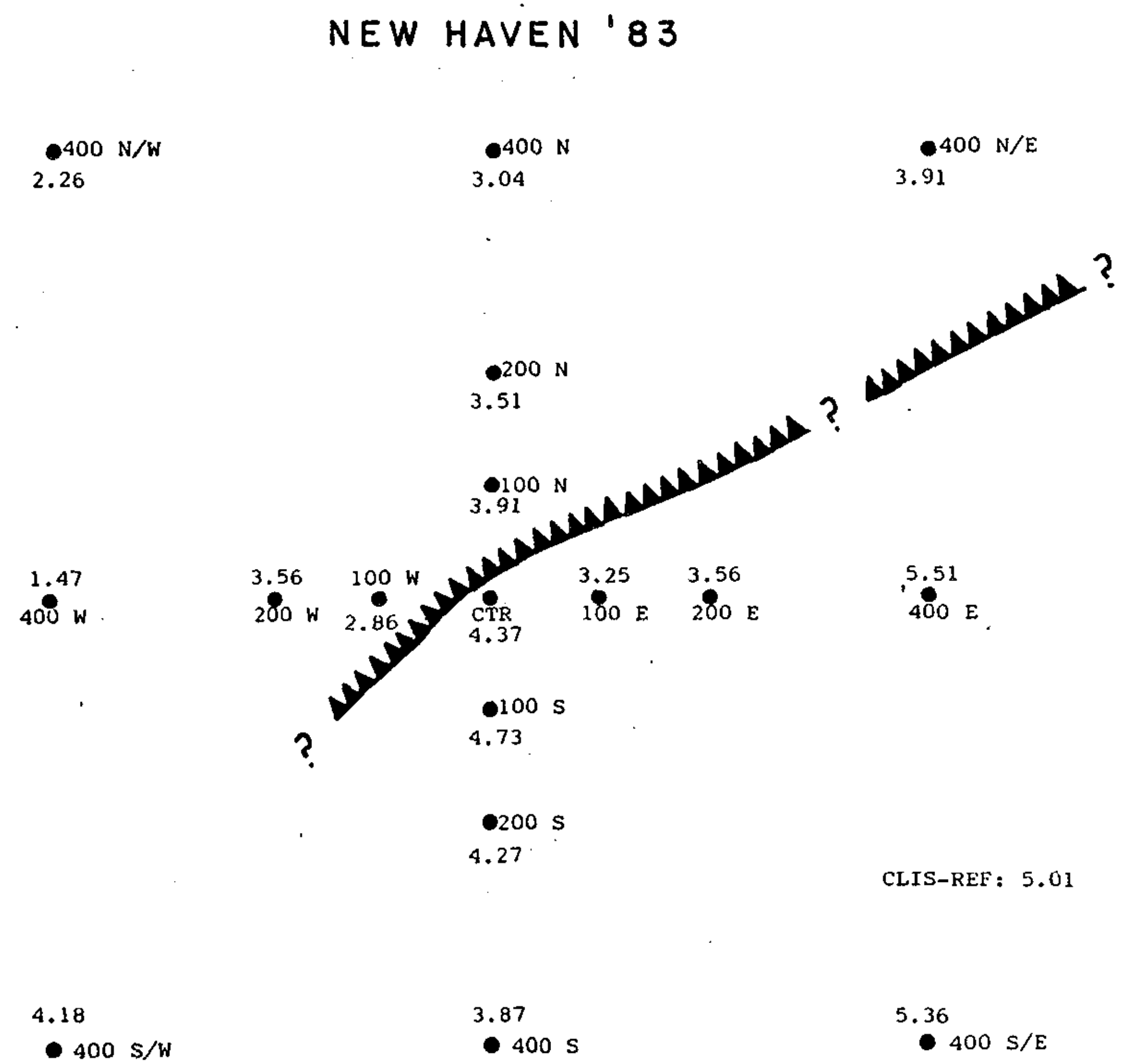

Figure II-3-15. Depth of the Redox Potential Discontinuity (RPD), October 1983. Values at each station (cm) are the mean of three replicates.

This delimits the area of dredged material where the redox is shallower than that of the CLIS-REF station (3.5 cm) and the surrounding bottom, particularly stations 300S/E and 400S/E, which have not been affected by disposal in the past, and station 700W which is located on pre-existing dredged material.

The redox boundary tends to be deeper near the margins of the freshly deposited material (Fig. II-3-16). This observation suggests that, in regions of the disposal site where dredged material thickness is 4 cm, infauna buried by the material were able to burrow upward, and immediately reestablish themselves, and resume bioturbational pumping. In areas of the disposal site where material is thicker than 4 cm, recolonization may have been delayed as repopulation took place by larval recruitment or passive washing-in of adult polychaetes from the ambient bottom.

The frequency distribution of RPD depths between the baseline survey and post-disposal surveys is shown in Figure II-3-17. A dramatic shift to shallower redox depths can be seen following disposal (3.1 cm to 4.0 cm in the baseline to 1.1 cm to 2.0 cm after disposal). Winter conditions have apparently also contributed to a rebound in the RPD as the CLIS-REF station changed over this period from a value of 5.0 cm (October) to 3.5 in January.

With the exception of stations 100N and 100W, which are located near the edge of the area affected by dredged material, all stations located within the dredged material area during the pre-disposal survey are represented by a patchy mosaic of Stage I and Stage II-I infauna (Fig. II-3-18). The scale of this patchiness is on the order of the spacing of the station replicates. No Stage I (only) seres are found outside of the dredged material area; all stations are populated by Stage III or III-I seres that are located on the ambient bottom. Figure III-3-19 shows the successional stage values from all replicates at each station after disposal. All stations located on newly deposited dredged material are in Stage I sere. Stations 400N/W, 400N/E, and 500N/E may, or may not, be located on dredged material. The high successional stages at these stations suggest that, if dredged material exists at these stations, it predates this disposal operation. Stations 300S/E and 400S/E have uniformly high successional stages as might be expected as they lie outside of the area affected by dredged material.

Habitat indices on newly deposited dredged material are mostly within the range of 4 to 5 (Figs.1 II-3-20 and 21). In the baseline survey, only 7 station replicates out of 24 (30%) had values less than five, while over 80% of the post-disposal survey are 5 (Fig. II-3-22). The major habitat index mode in the baseline survey was 11 (n=30). This mode was shifted downward to a major mode of 4 (n=29) in the post-disposal survey. The pre-disposal survey (Fig. II-3-23) showed that winter habitat indices of 6 represent highly disturbed habitats. One replicate of station 200E showed a -4 index value. No positive redox was observed at the sediment surface and no benthic

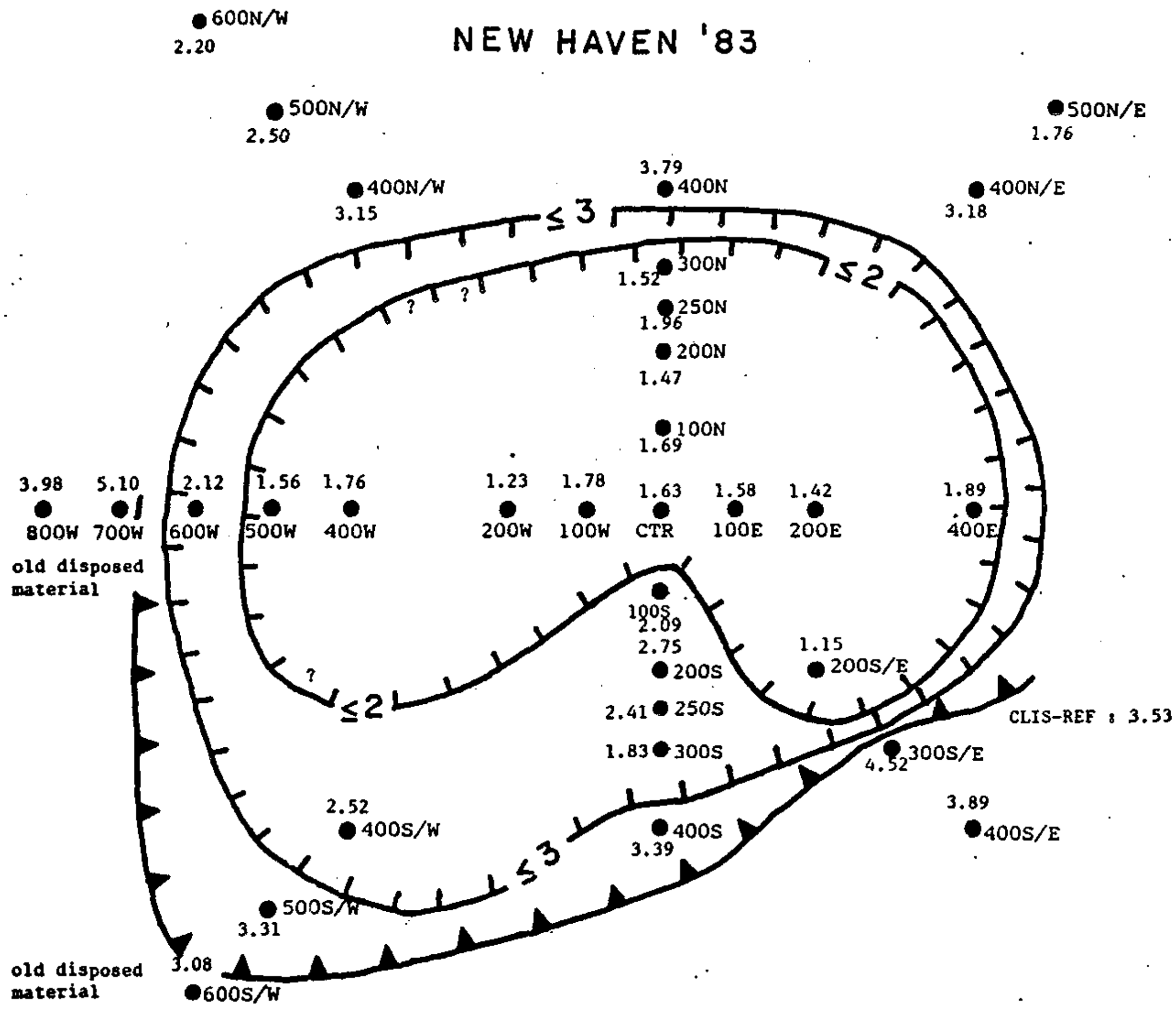

Figure II-3-16. Contour map of RPD depths for New Haven-83 stations, January 1984. Contour values are in cm. The ? symbol indicates areas where exact location of contour is uncertain. Arrowed lines mark the southern and western boundary of dredged material.

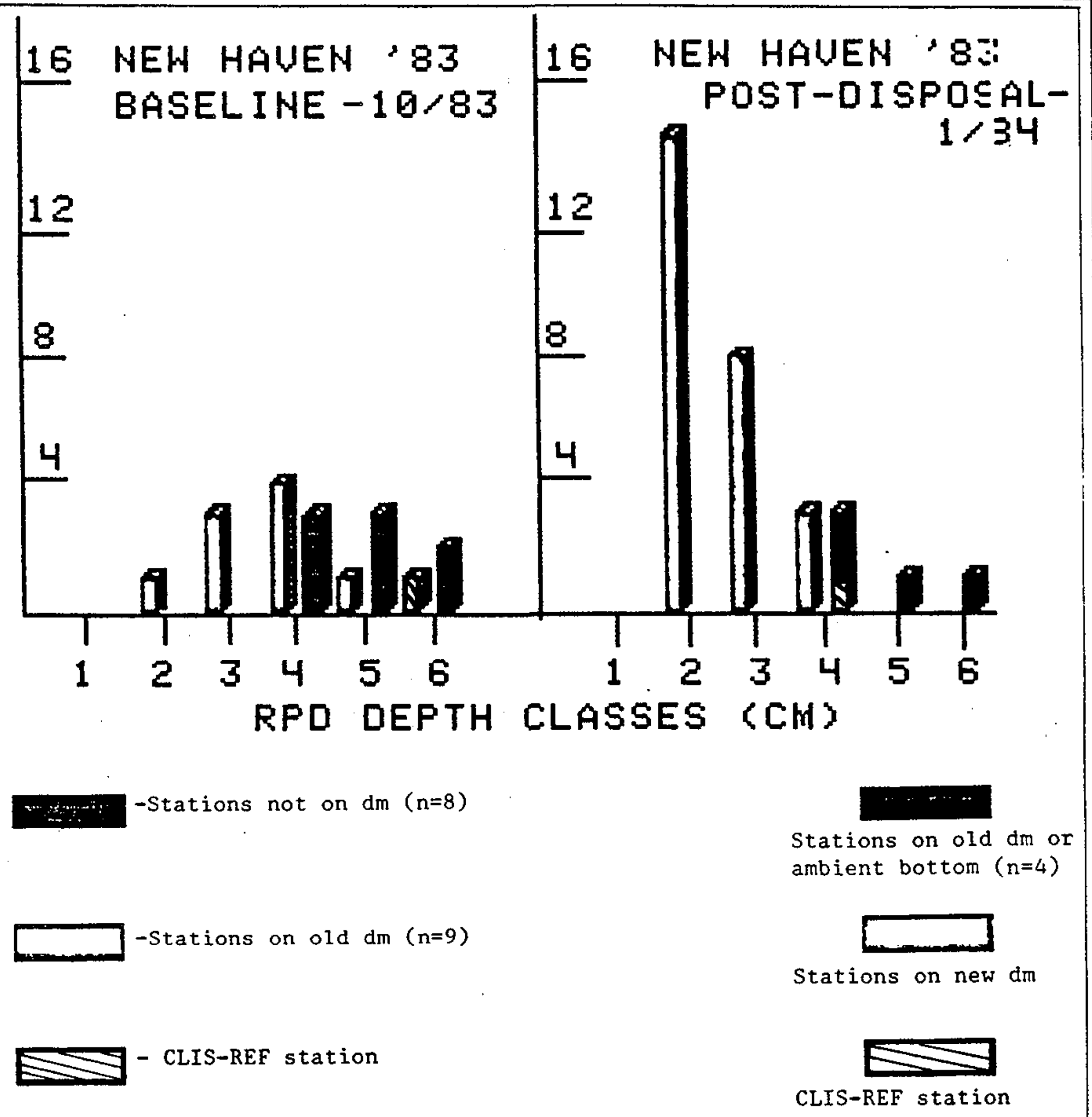

Figure II-3-17. Frequency distribution of RPD depths at NHAV 83.

NEW HAVEN '83

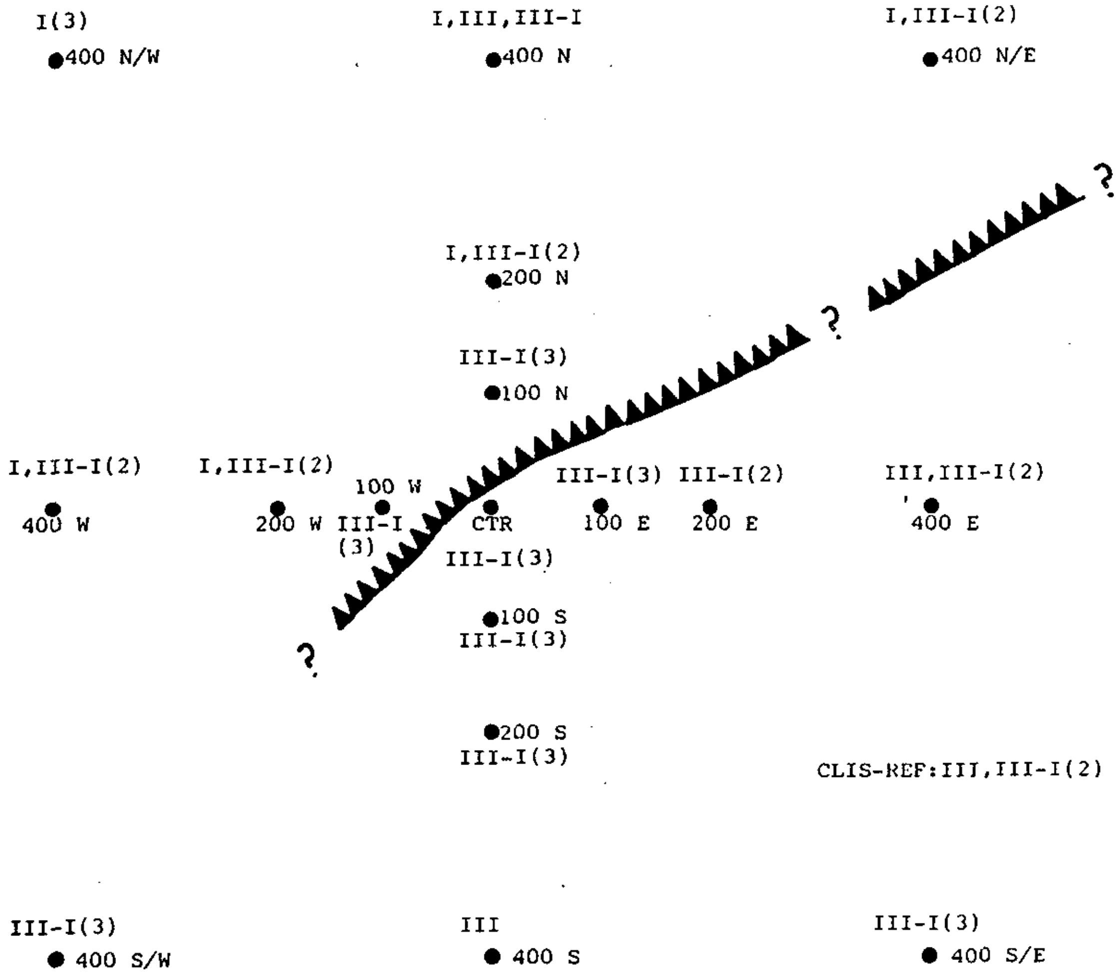

Figure II-3-18. Successional stage values at NHAV 83 stations, October 1983. Numbers in parentheses indicate the number of replicate images for that particular value.

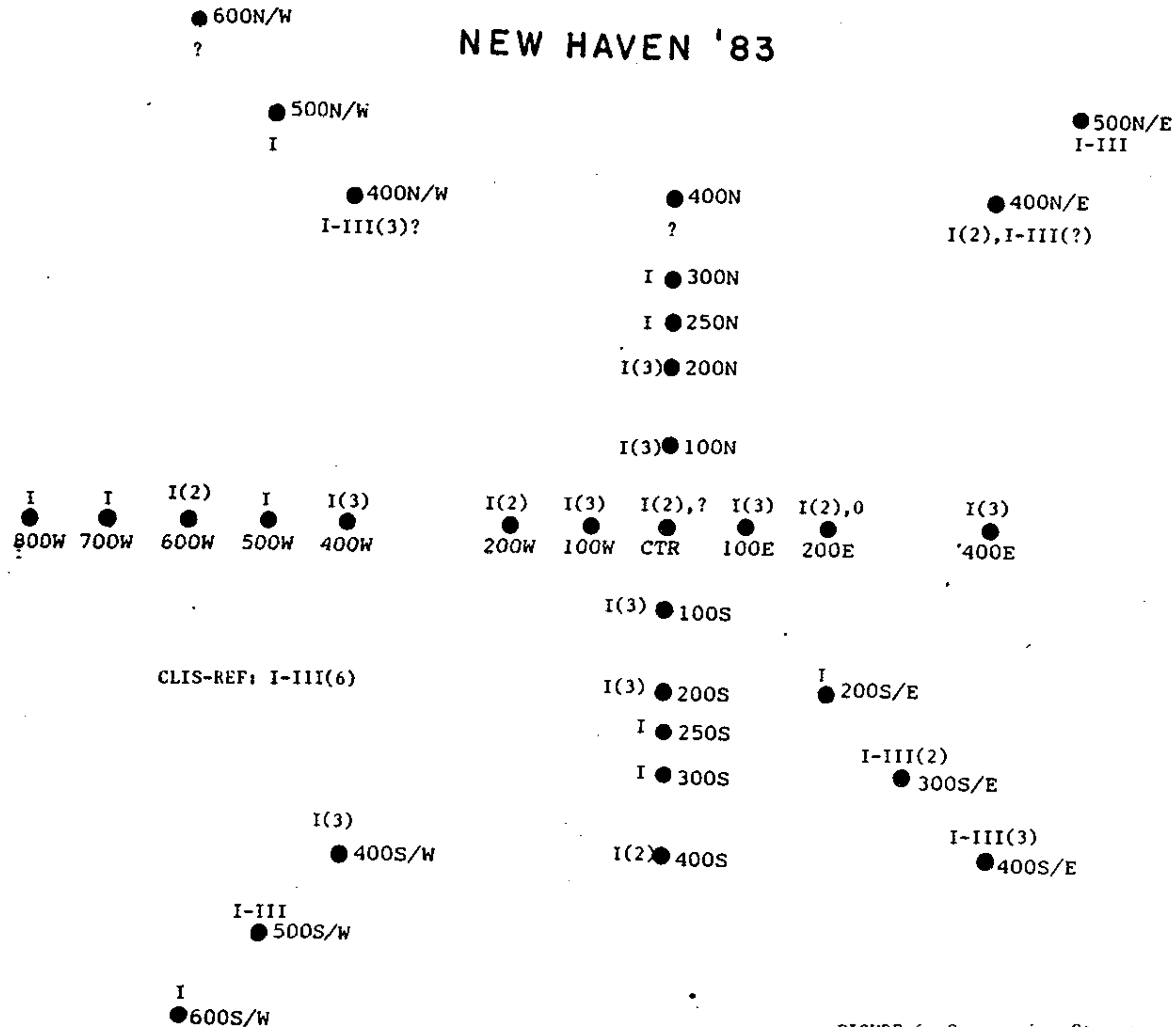

FIGURE 6 Succession Stages

Figure II-3-19. Successional stages, January 1984.

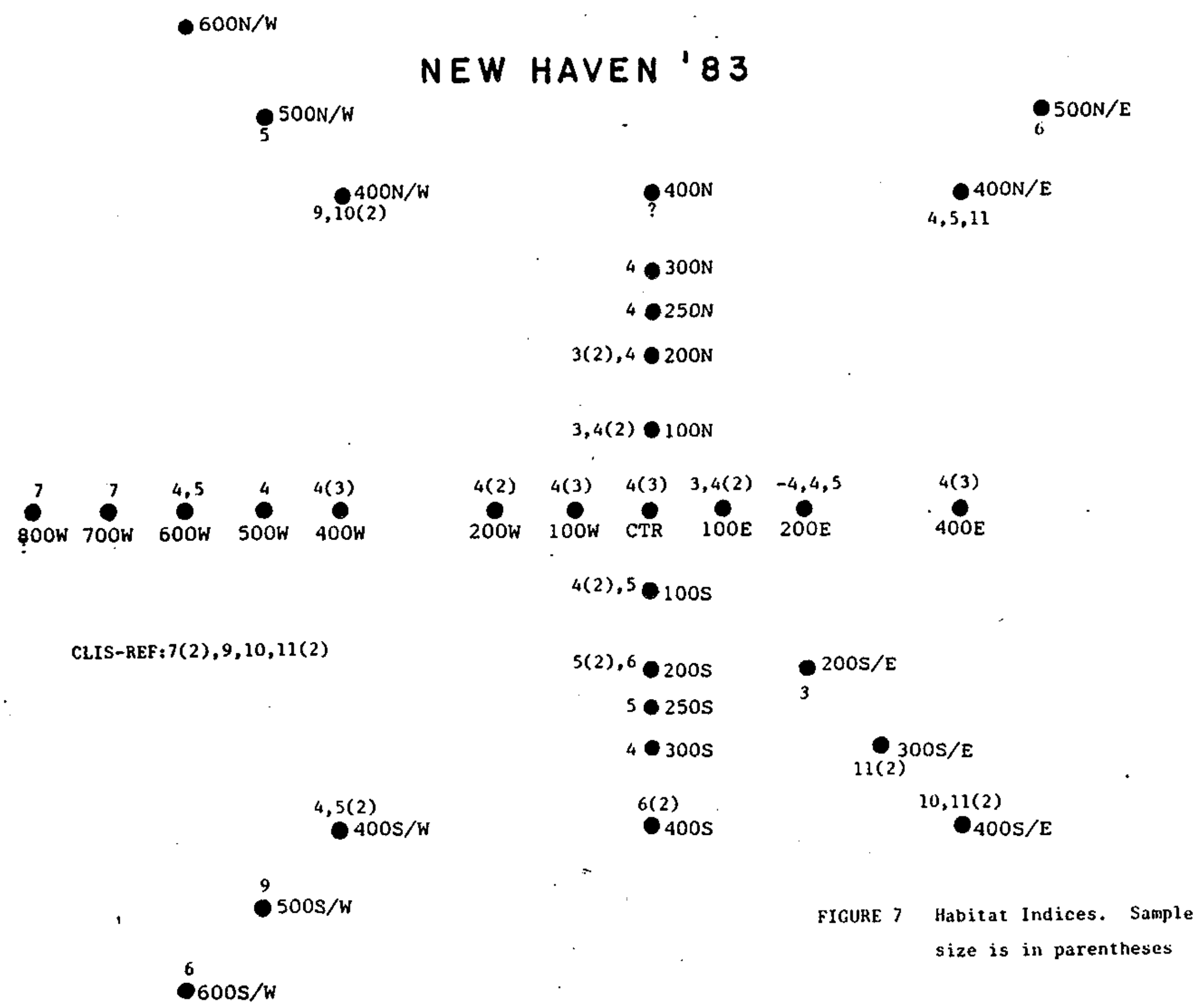

Figure II-3-20. Habitat indices for NHAV 83, January 1984.

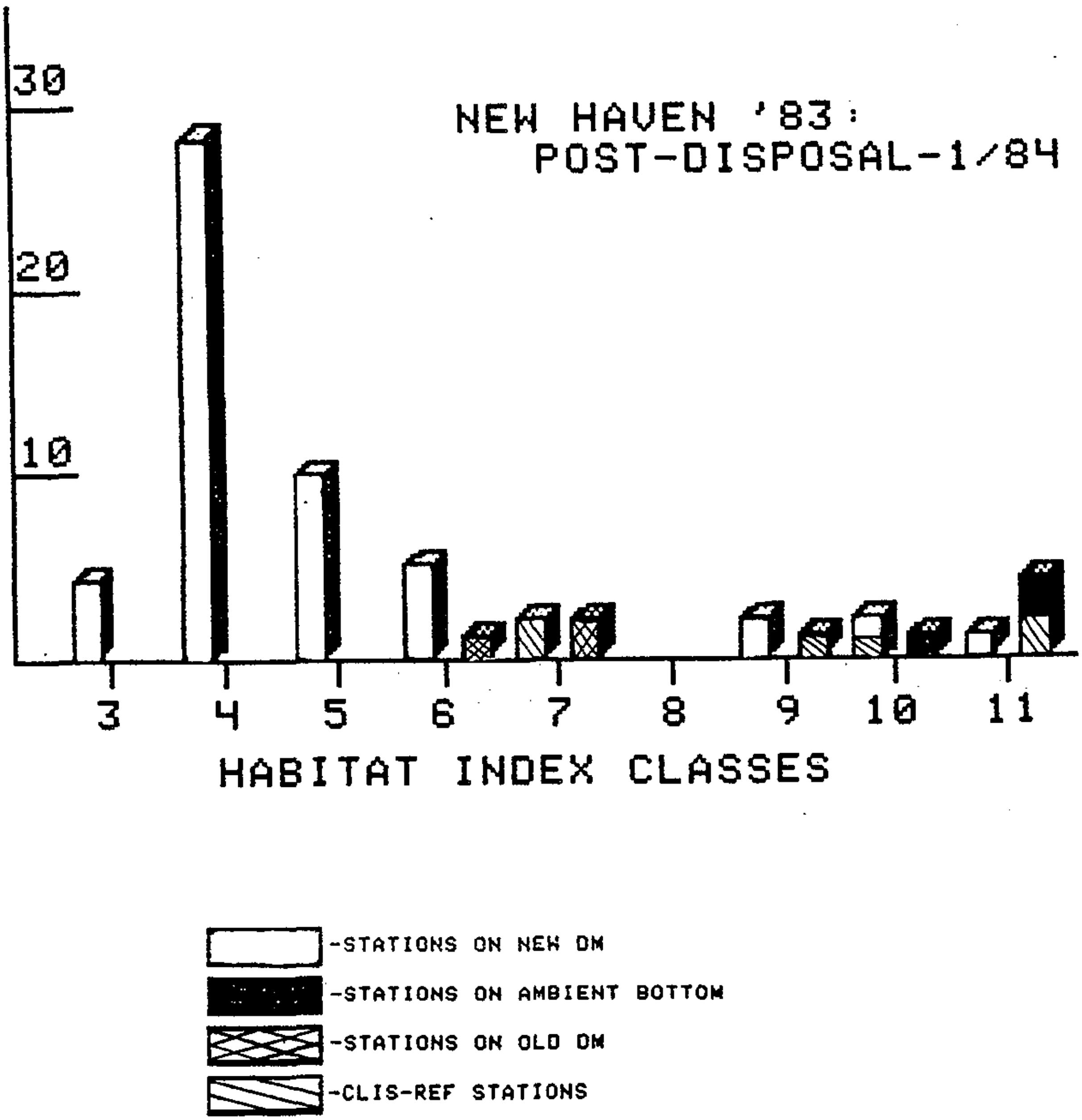

Figure II-3-21. Frequncy distribution of habitat indices at NHAV 83, january 1984.

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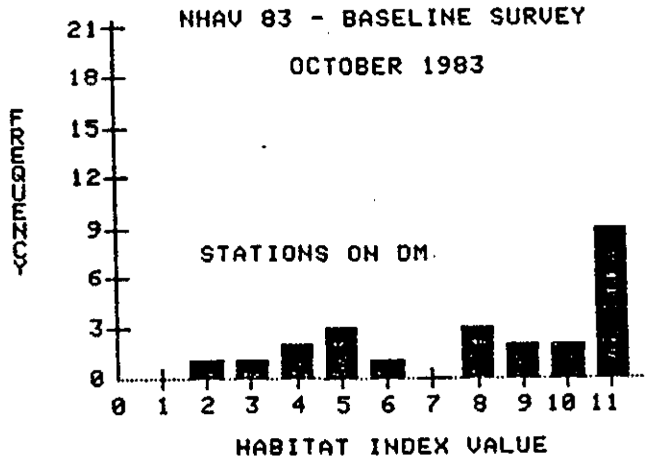
A)



B)

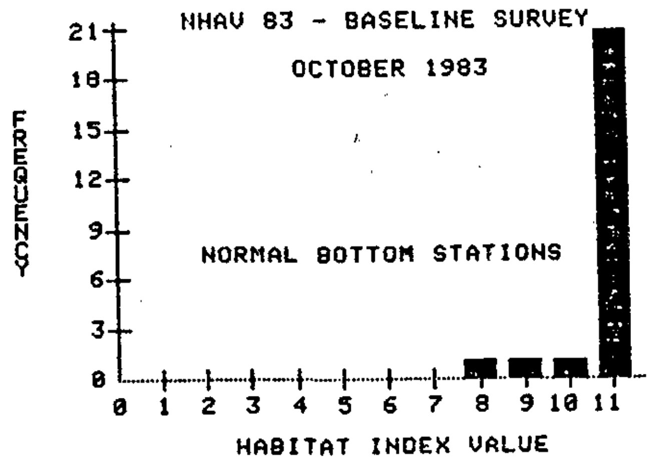


Figure II-3-22. Frequency distributions of habitat index values for NHAV 83 stations located on (A) disposed materials and (B) ambient bottom.

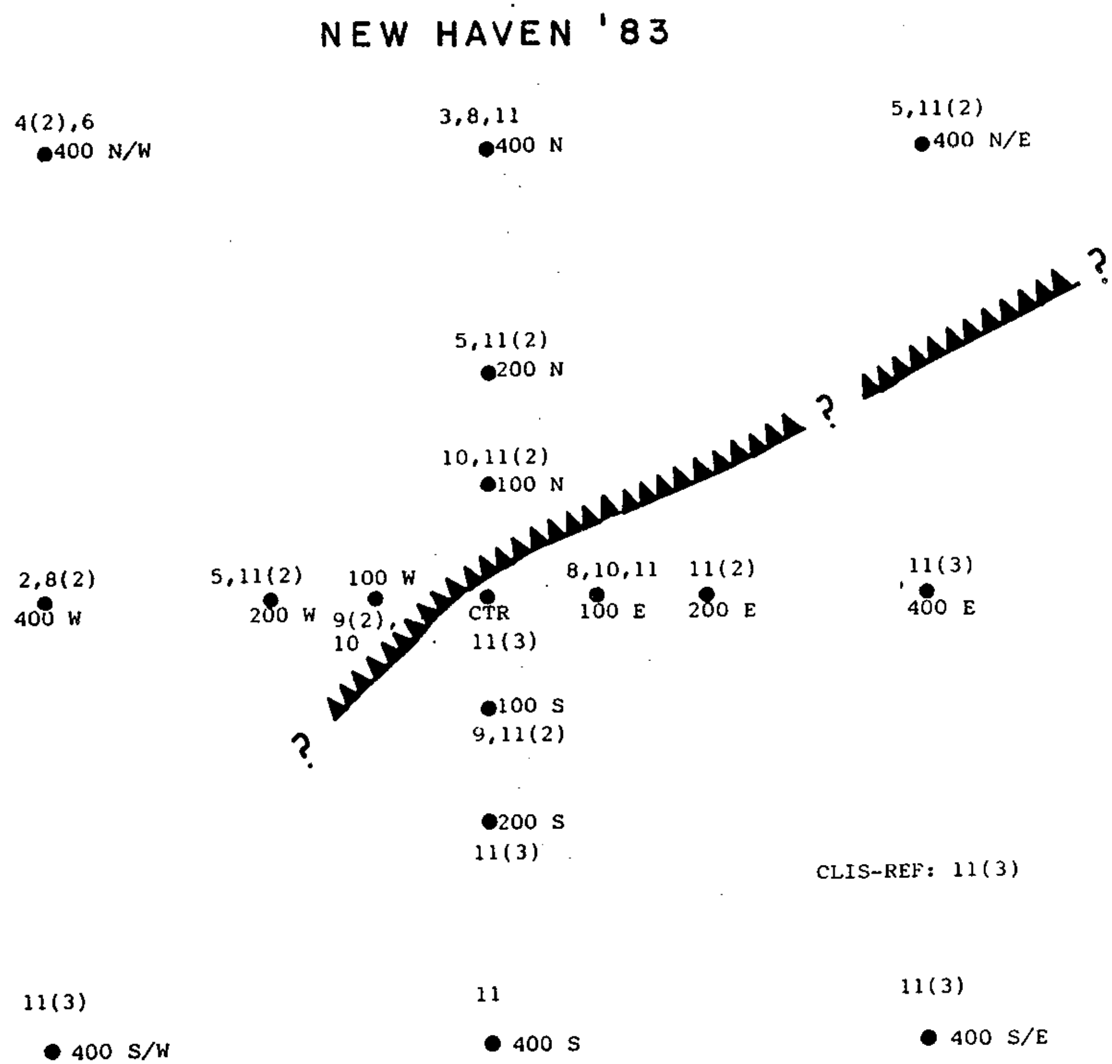


Figure II-3-23. Habitat index values at all New Haven 83 stations.

colonizing organisms were visible.

3.5 *Underwater Operations*

Past experience at the CLIS disposal area has shown that there has been a small loss of material from individual disposal mounds. There are several methods which can be used to estimate the volume of material deposited at a disposal site and subsequent changes in that volume. The method commonly used on the DAMOS program involves calculations based on the data acquired during bathymetric surveys. In this process, the gridded depths obtained during a baseline survey are subtracted from those acquired during a subsequent post disposal survey. It is then possible to calculate the volume difference of each grid cell in the survey area. The summation of each individual cell volume difference yields the total volume change over the entire area. In addition, the total of all cells along a single lane can be used to provide an accurate picture of the physical distribution of material within the survey area. The data generated in this process are then used to produce various final products such as volume graphs, contour difference plots and three dimensional plots. Estimation of the fathometer error and repeat surveys have shown this method to be accurate to $\pm 2000 m^3$ in an 800 meter square survey. Other methods of estimating volume include using the combined data from diver observations, sediment sampling and REMOTS photographs. There are several possible explanations which can account for the apparent loss of material, including lateral transport via erosion or resuspension, sediment compaction and bottom deflection under the mound. The first of these hypotheses is currently undergoing extensive study at the FVP disposal site by several different groups of researchers utilizing various measurement techniques. Being present at the inception of the NHAV-83 disposal site has afforded an excellent opportunity to address the latter two theories in great detail. The possibility that sediment compaction may be taking place will be pursued using two different measurement methods.

Prior to disposal, sediment compaction stakes were deployed by divers at stations located 25 and 50 meters long an east/west transect extending through a point 25 meters south of the disposal buoy. These stakes consist of 10 foot lengths of 1 1/2" PVC pipe supported by a 5 foot iron pipe which was driven into the bottom to a depth of 2 feet. In order to lessen the possibility of lateral movement, this assembly is further strengthened through the use of angle iron braces which were driven into the sediment to a depth of 1 foot. A similar experiment was attempted at the two cap sites, but evidently did not survive the disposal operation. It is hoped that the addition of these strengthening members and the use of heavier gauge PVC will enhance their survivability. Each length of PVC was clearly marked at 10 cm intervals, beginning at the top. It will be possible for a diver to assess the extent of compaction and/or erosion by measuring the exposed pipe soon after cessation of disposal and then repeating this process during later cruises and making note of any changes in the length of exposed pipe.

A more detailed study of sediment compaction will be made utilizing the Troxler nuclear density probe. This instrument operates on the principle of radiation backscatter and is capable of measuring in-situ sediment density. Measurements will be taken in the area immediately prior to dredging, in the scow enroute to the disposal site, in the mound after disposal, and also on a regular basis thereafter. The data thus obtained should provide a complete density history and may provide some insight into the mechanism of sediment compaction.

When calculating the volume of a disposal mound, it is necessary to assume that the sea floor under the disposal mound remains unchanged after deposition of the dredged material. Should any sinking or subsidence occur, the bottom deformation would show up as an apparent loss of material. In order to address this question, SAI has developed a system which should provide quantitative data on the nature and extent of any subsidence which is occuring. The Bottom Deflection Measuring Device (BDMD) is simply a sonar target which is placed at the center of the disposal point and consists of a 3 foot square steel plate supporting a 10 foot vertical PVC pipe. This pipe is marked at 10 cm intervals in the same manner as the compaction stakes and will serve a dual purpose in post disposal surveys. In operation, divers will place a 2 1/2 foot square acoustic target on the top of the vertical pipe. It is then possible to measure the depth over the target using the model DC-719 208 KHz sonar. The BDMD was deployed at a point approximately 25 meters south of the disposal buoy, which past experience has shown to be the point of maximum deposition. The BDMD was tethered to the disposal buoy mooring to aid in its recovery and also was marked with a 38 KHz acoustic pinger. BDMDs were deployed during the CS-1 and CS-2 capping experiments and survived the disposal operation quite well.

Baseline measurements of the BDMD were made on 27 October and Figure II-3-24 depicts the echogram obtained at that time. The BDMD can be clearly seen rising 10 feet above the surrounding sea floor. In order to detect any vertical movement of the bottom, the depth of water over the BDMD is compared to that over a known reference point located well off of the disposal mound. this yields an arbitrary value equal to the arithmetic difference between the two depths. After disposal operations have been completed, these measurements will be repeated and any change in the difference depth may be attributed to a vertical displacement in the BDMD. This process can be expressed mathematically by the expression $D = (Z_{RB} - Z_{MB}) - (Z_{RP} - Z_{MP})$ where: D = Bottom Deflection; Z_{MB} = Baseline Depth over Disposal Mound; Z_{RB} = Baseline Depth over Reference Site; and Z_{MP} and Z_{RP} = Post Disposal Depth over the Mound and Reference Site, respectively. Measurements made in October showed a depth over the BDMD of 48.7 feet and the depth at the reference site of 57.9 feet, which is a difference of 9.2 feet. This quantative data should provide information for validation of models which will account for bottom deflection noise and enhance

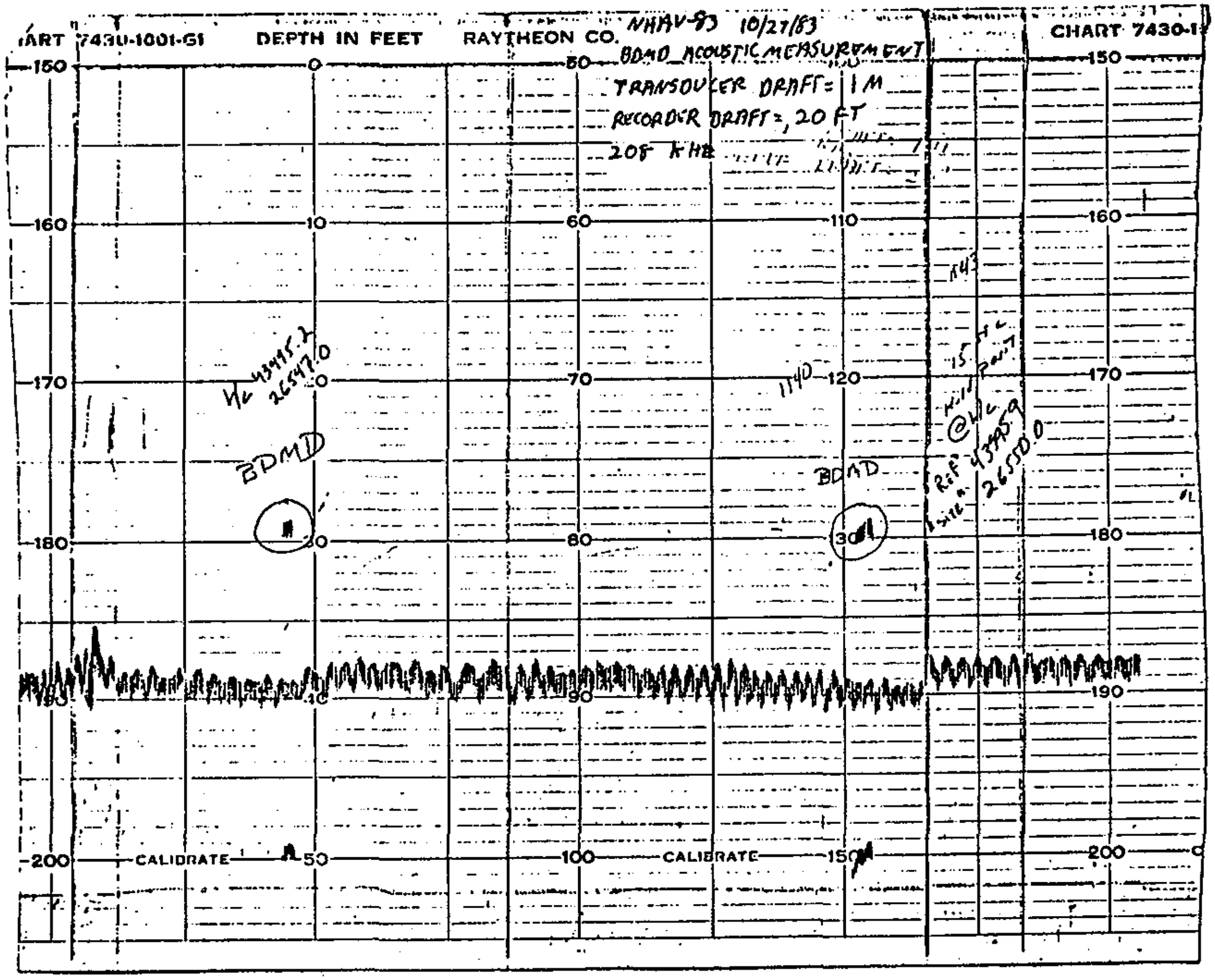


Figure II-3-24. Echogram Showing BDMD.

the accuracy of the volume difference calculations.

4.0 IMPACTS OF A STORM EVENT ON DREDGED MATERIAL DISPOSAL MOUNDS AT THE CLIS SITE

During a 48 hour period from 29-31 March 1984, a severe storm event passed over the CLIS disposal site, creating a potential for sediment movement that had not occurred during the previous two years. The storm contained winds in excess of 60 knots and seas in Long Island Sound were reported as greater than 3 meters. Since this storm had the potential to erode and transport dredged material at the CLIS disposal site, a two-phased effort was initiated to determine whether or not any effects could be observed.

The first phase of the study consisted of conducting replicate precision bathymetric surveys over six of the disposal mounds existing at the CLIS site and comparing the results with surveys obtained prior to the storm. Using the standard DAMOS procedures for calculating volume differences, this approach should provide an indication as to extent and location of any dredged material movement.

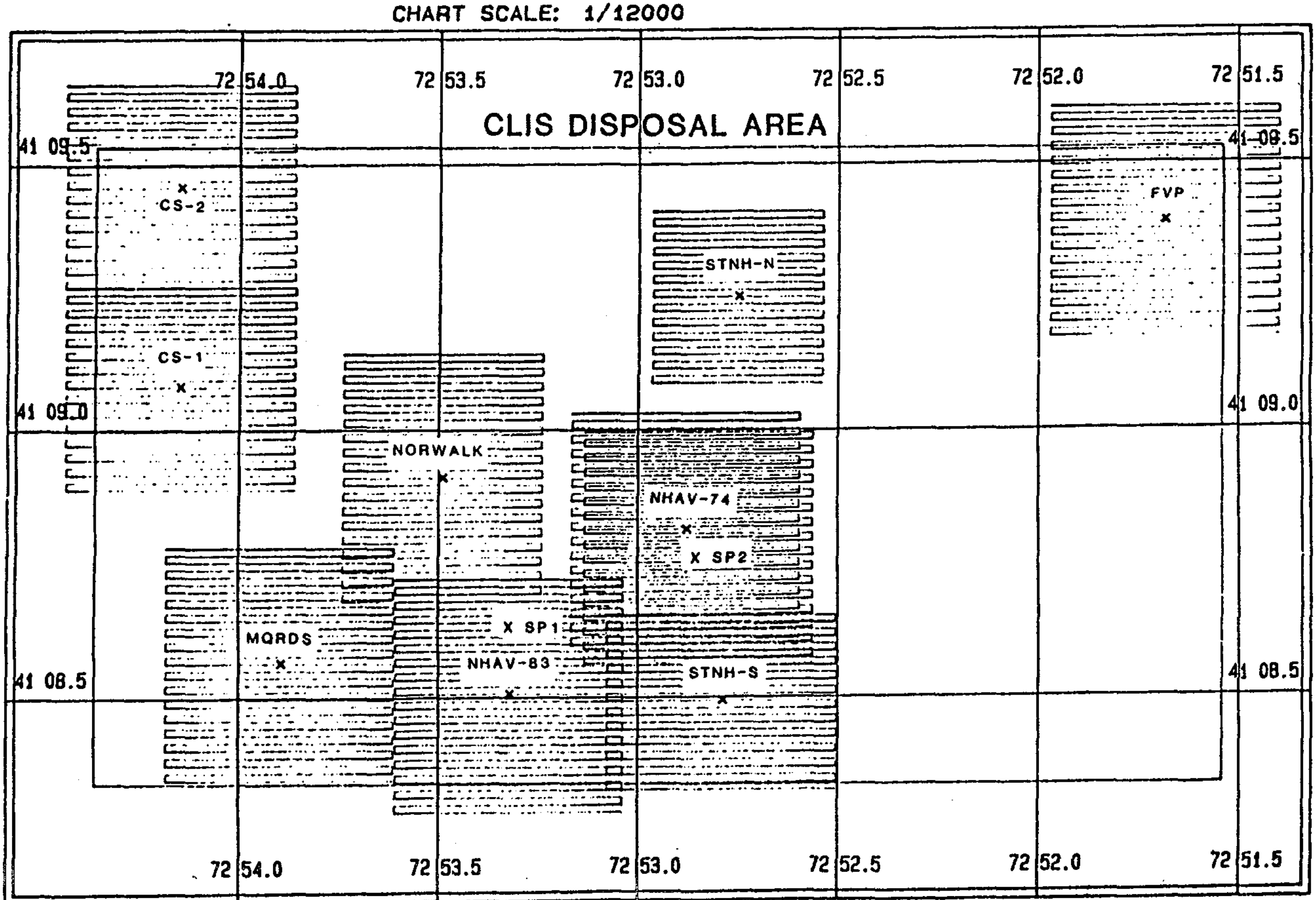
The second phase of the study results from studies undertaken as part of the Field Verification Program (FVP). In order to assess the transport of sediment in the bottom boundary layer in the vicinity of the FVP mound, the DAISY instrumentation system was deployed at the CLIS site during the period of the storm. This instrument provides data on suspended sediment load, bottom current velocity, wave energy at the bottom and various other parameters related to the interaction between the water column and the sediment. Since these data are available to quantify the energy and response of the suspended sediment load to storm conditions, a second phase has been initiated to assess these parameters. In addition to in-situ measurements, this phase of the program will document the characteristics of the storm, generate wave hindcast data, and place the storm in perspective to other such events that have occurred in the area.

Both of these studies are currently underway and analysis is not complete; however, some preliminary results from the post-storm surveys are available and are provided in the following sections. Consolidation of both phases of the project and a report on the impact of the storm will be presented at the DAMOS symposium in January 1985.

4.1 Field Measurements

Precision bathymetric surveys were made over all six of the grids presented in Figure II-4-1 using the SAIC Navigation and Data Acquisition Sytem to acquire depth data. The grids at FVP, NHAV-83, STNH-N, STNH-S, CS#1 and CS#2 sites were all run with 25 meter lane spacings for comparison with previous surveys. Because of scheduling conflicts, the R/V BEAVERTAIL from Jamestown, RI was used in place of the R/V UCONN. However, to

Figure II-4-1. Central Long Island Sound Disposal Area (CLIS)



insure consistency with previous surveys, the antenna-transducer configuration was installed with exactly the same measurements as those of the UCONN.

The Del Norte positioning system was calibrated prior to the survey period and daily checks of calibration were performed through baseline crossings between New Haven and Stratford Point lighthouses during transit to and from the site. A bar check was performed on the 719D fathometer before and after each survey and the SSD-100 digitizer was set to agree with the charted record of the fathometer. The transducer was attached to the side of the vessel with a draft of one meter.

The survey grids were all run at a speed of approximately 7 knots, and depth measurements were recorded with associated positions at one second intervals throughout the survey. At the completion of the survey grid, the first lane was run again to provide a check on tide correction.

4.2 Analysis Procedures

The survey data were processed using standard DAMOS procedures described in Morton (1980) and in Volume IV of this report. All transects were plotted as vertical depth profiles and compared with previous data to provide a lane by lane assessment of topographic differences. Data were then gridded according to a 12.5 x 25 meter grid matrix for development of contour charts. These grids were identical to previous suveys and were then subtracted on a cell by cell basis to obtain volume difference measurements and a contour difference chart. Corrections for offsets between surveys were made using the windowing technique described in Volume IV of this report.

4.3 Results of Bathymetric Survey Analysis

The data obtained as a result of the surveys conducted between 11 and 13 April 1984 are presented according to disposal site in the following sections.

4.3.1 FVP Site

The FVP survey provides a potential opportunity to evaluate the relative importance of the storm event compared to the background environment, since a survey was conducted at that site on 12 March 1984, just two weeks before the storm. A comparison of the August 1983 survey (Fig. II-4-2) and the March survey (Fig. II-4-3) shows very little change in the topography of the disposal mound. The base of the mound is defined by the 19.4 contour interval and the minimum depth is 18.2 meters.

Likewise, the contour chart of the post-storm survey on 11 April 1984 (Fig. II-4-4) shows very little change in either the shape or thickness of the mound. As in the previous surveys, the base of the mound is at 19.4 m and the minimum depth is 18.2 m. The volume difference chart (Fig. II-4-5) indicates a slight

FVP POST-DISPOSAL MONITORING

Figure II-4-2

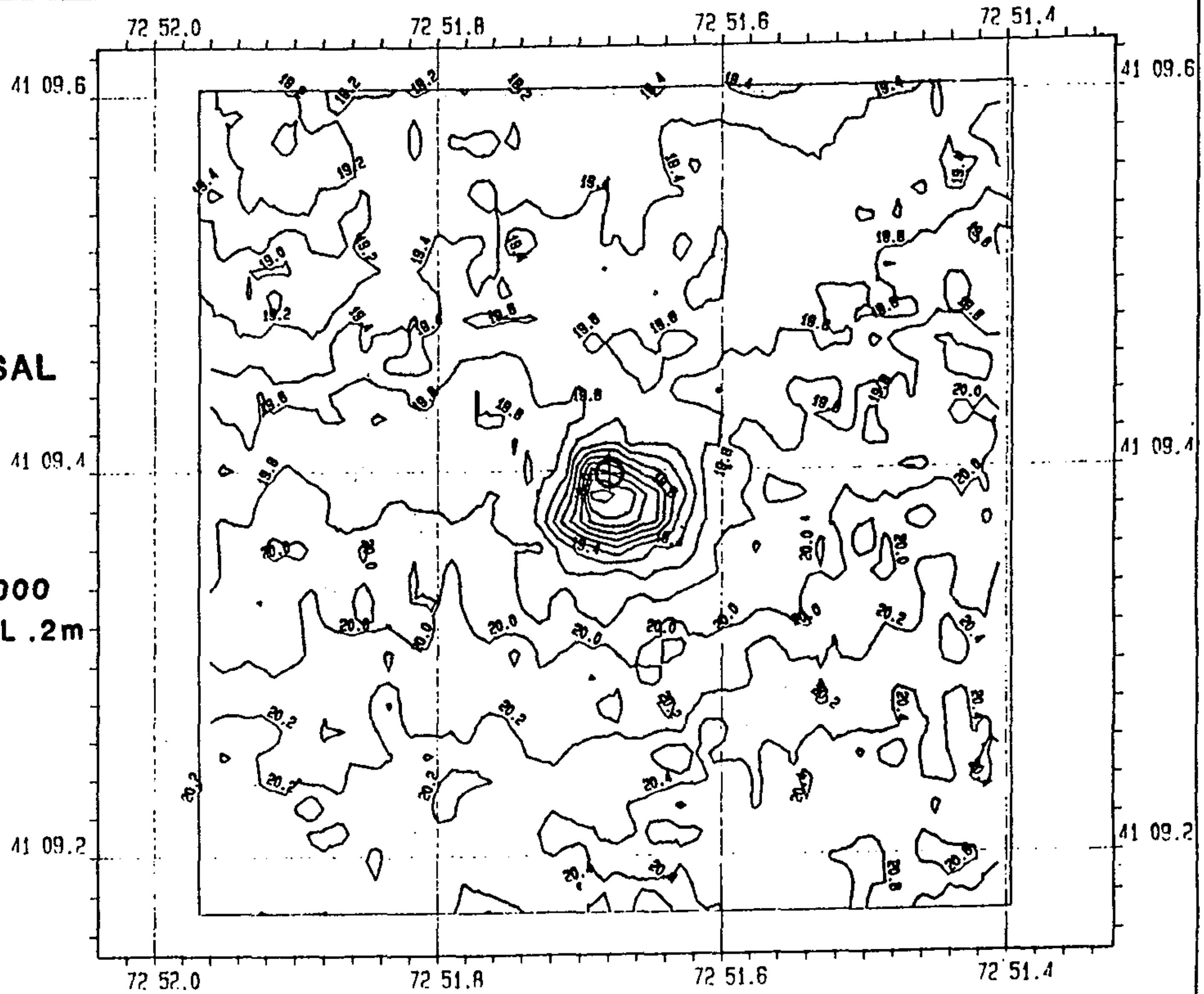
AUGUST 1983

CHART SCALE 1/4000

CONTOUR INTERVAL .2m

0 80 160

SCALE (m)



FVP

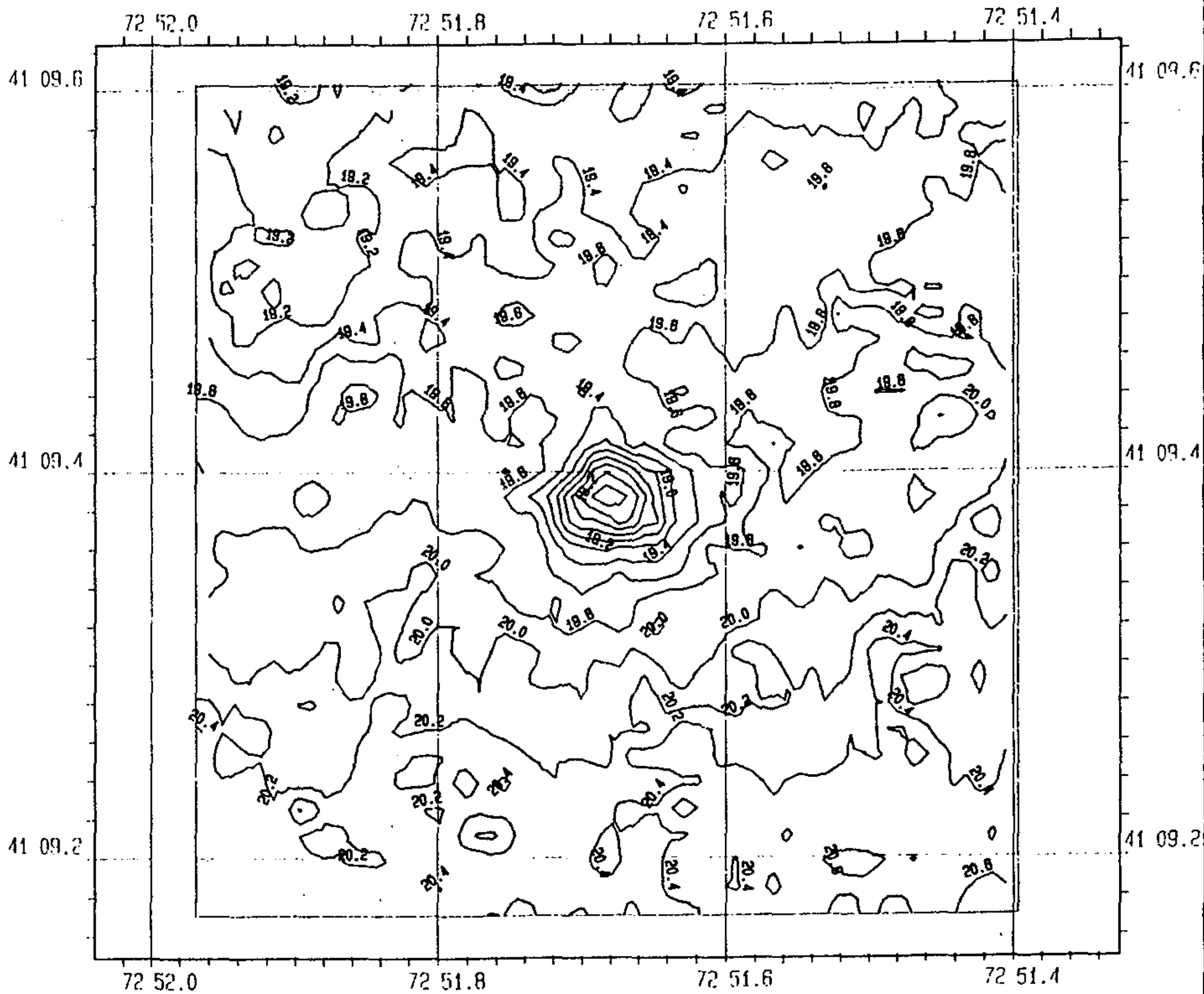
12 MARCH 1984

INTERVAL: 0.2m

SCALE: 1/4000

DATUM: MLW

FIGURE II-4-3



0 80 160

SCALE (m)

FVP

11 APRIL 1984

INTERVAL: 0.2m

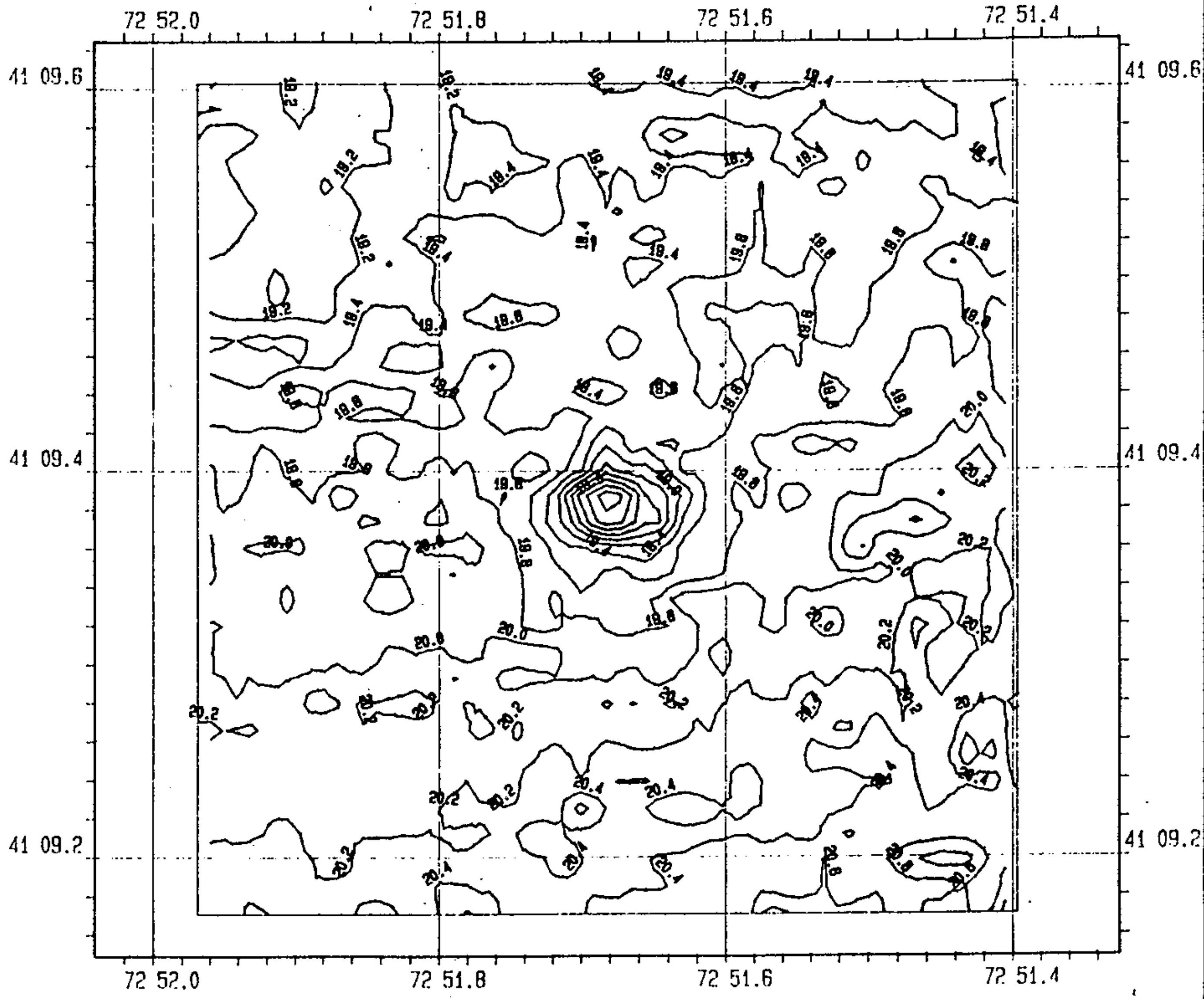
SCALE: 1/4000

DATUM: MLW

FIGURE II-4-4

0 80 160

SCALE (m)



FVP

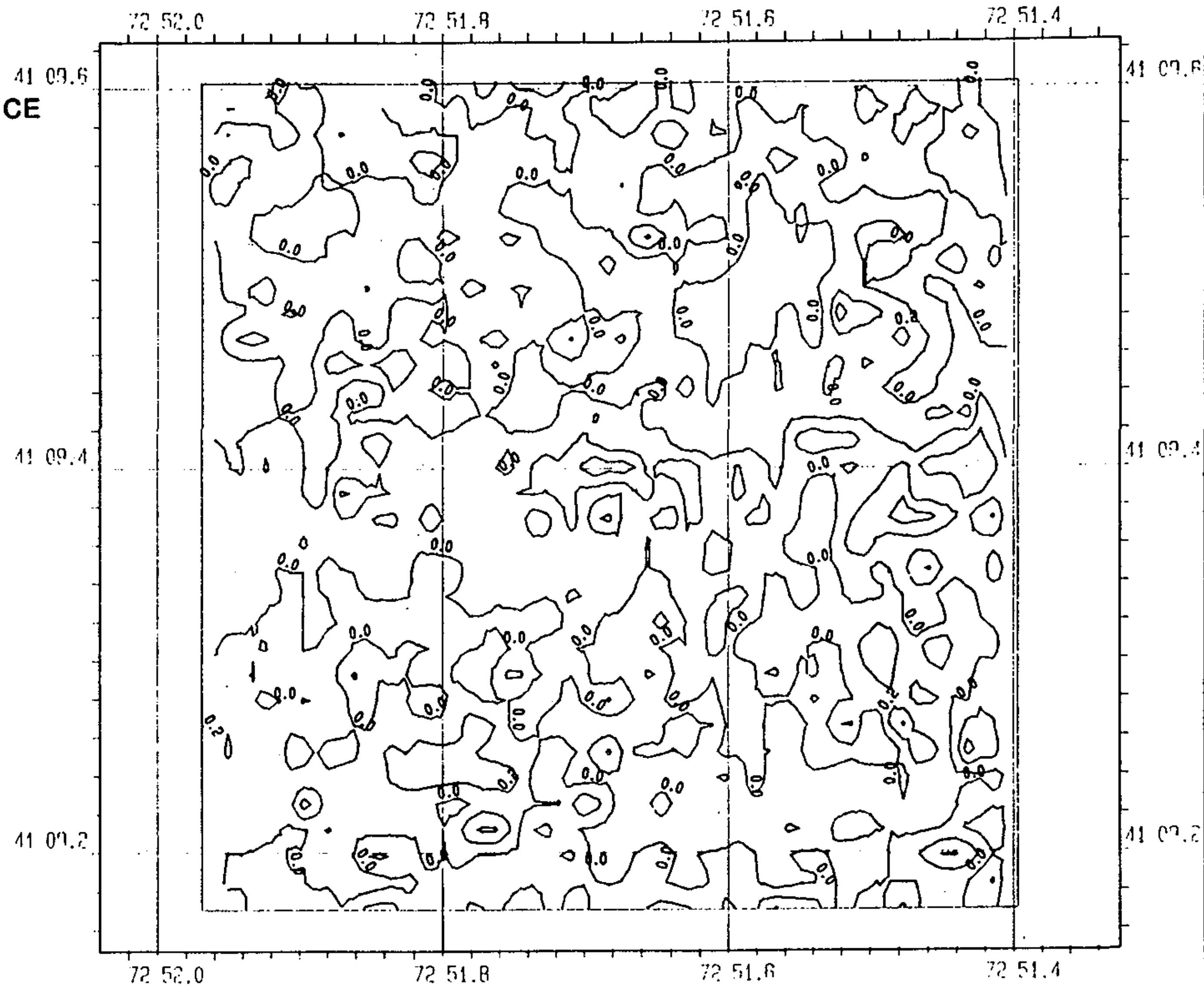
CONTOUR DIFFERENCE

APR84-MAR84

INTERVAL: 0.2m

SCALE: 1/4000

FIGURE II-4-5



0 80 160

SCALE (m)

loss on the north side of the mound, however, vertical profiles across the site (Fig. II-4-6) do not indicate significant changes. The volume difference between the April and March surveys was approximately 1200 m^3 which is within the error of the survey technique.

In summary, the topography of the FVP mound is essentially unchanged either as a result of background energy levels or the storm event. It is interesting to note, however, that sediment sample observations of the site have shown a gradual trend toward coarser material near the center of the mound. This may indicate that even though the overall topography does not change, there is still a possibility that winnowing of fine material may be occurring. Consequently, the importance of measuring multiple parameters to evaluate impacts is emphasized on this study.

4.3.2 Cap Site #1

Following disposal of New Haven material at Cap Site #1, an elliptical mound oriented in a SW-NE direction was developed with a base at 17.8 meters and a minimum depth of 15.4 meters. This configuration was maintained through the post-disposal survey in August 1983 (Fig. II-4-7). The post-storm survey in April 1984 (Fig. II-4-8) showed very little change from the August survey. A slight increase in depth is evident on the southwest portion of the disposal mound (Fig. II-4-9), which is evident on transect 19 of the vertical depth profiles (Fig. II-4-10). Because the profile maintains the same topographic expression from August to April, it is more likely that the depression results from settling of the mound through compression of the capped or capping material rather than erosion due to the storm event.

At the present time, there are no real indications that the storm event caused any major impact at the CS #1 site.

4.3.3 Cap Site #2

At the completion of capping operations at Cap Site #2, the mound was triangular with the sand covering the entire deposit, but much thicker on the southwest margin of the deposit. This configuration was reflected in the August 1983 survey (Fig. II-4-11) with a base depth surrounding the deposit at 16.8 meters and a minimum depth of 15.6 meters near the center of the deposit. The contour chart resulting from the April survey (Fig. II-4-12) shows a flattening and broadening of the mound in the northwest section. This is emphasized by the contour difference chart (Fig. II-4-13) which shows a .6 m increase on the nortwest side of the mound. This increase has the appearance of a bad data point, but a review of the vertical profiles (Fig. II-4-14a and b) all show a decrease in overall mound height and a shift to the west (transect #'s increase to the south).

In contrast to the CS #1 data, these profiles (14, 15 and 16) do not show topography consistent with previous surveys,

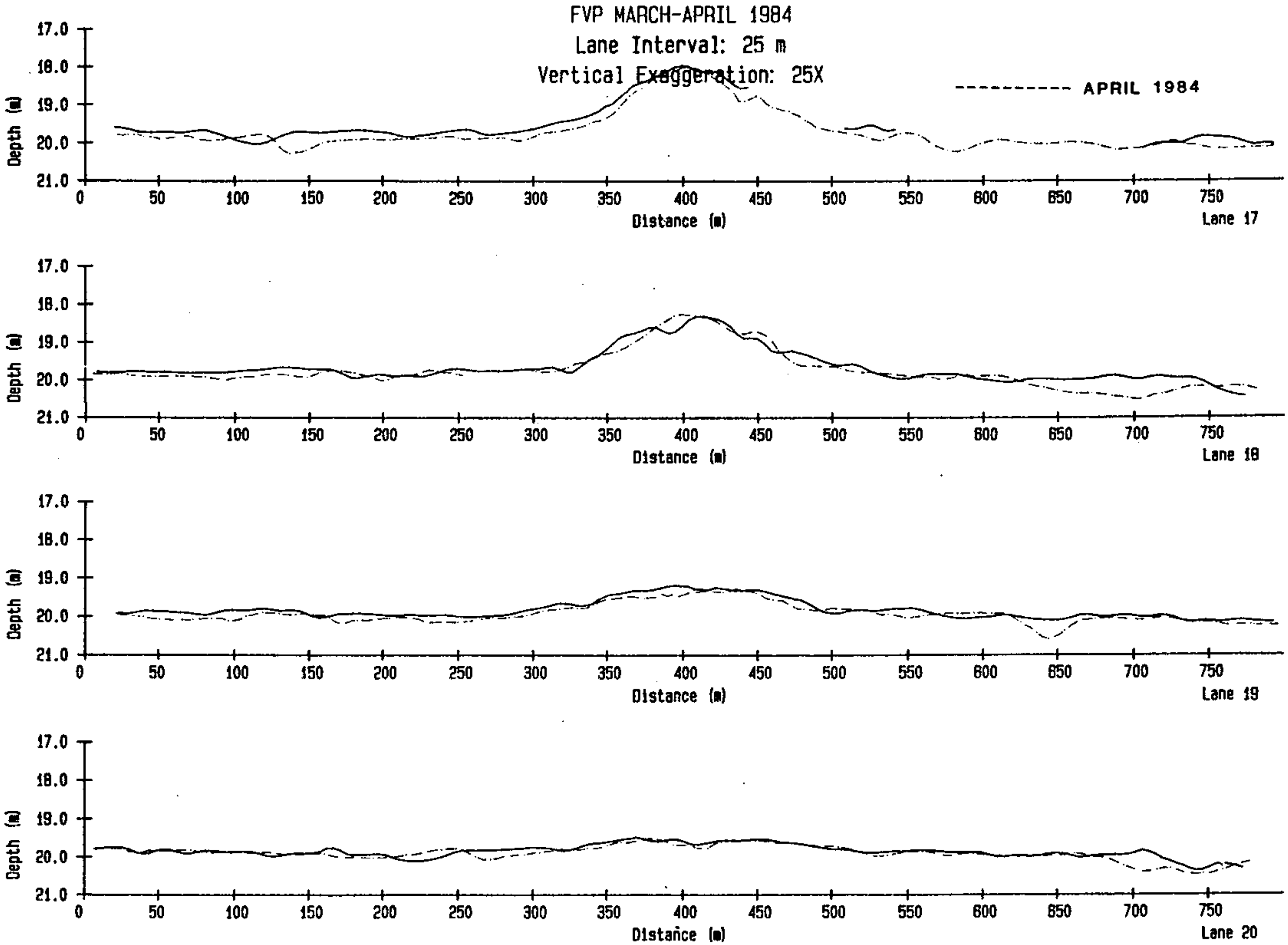
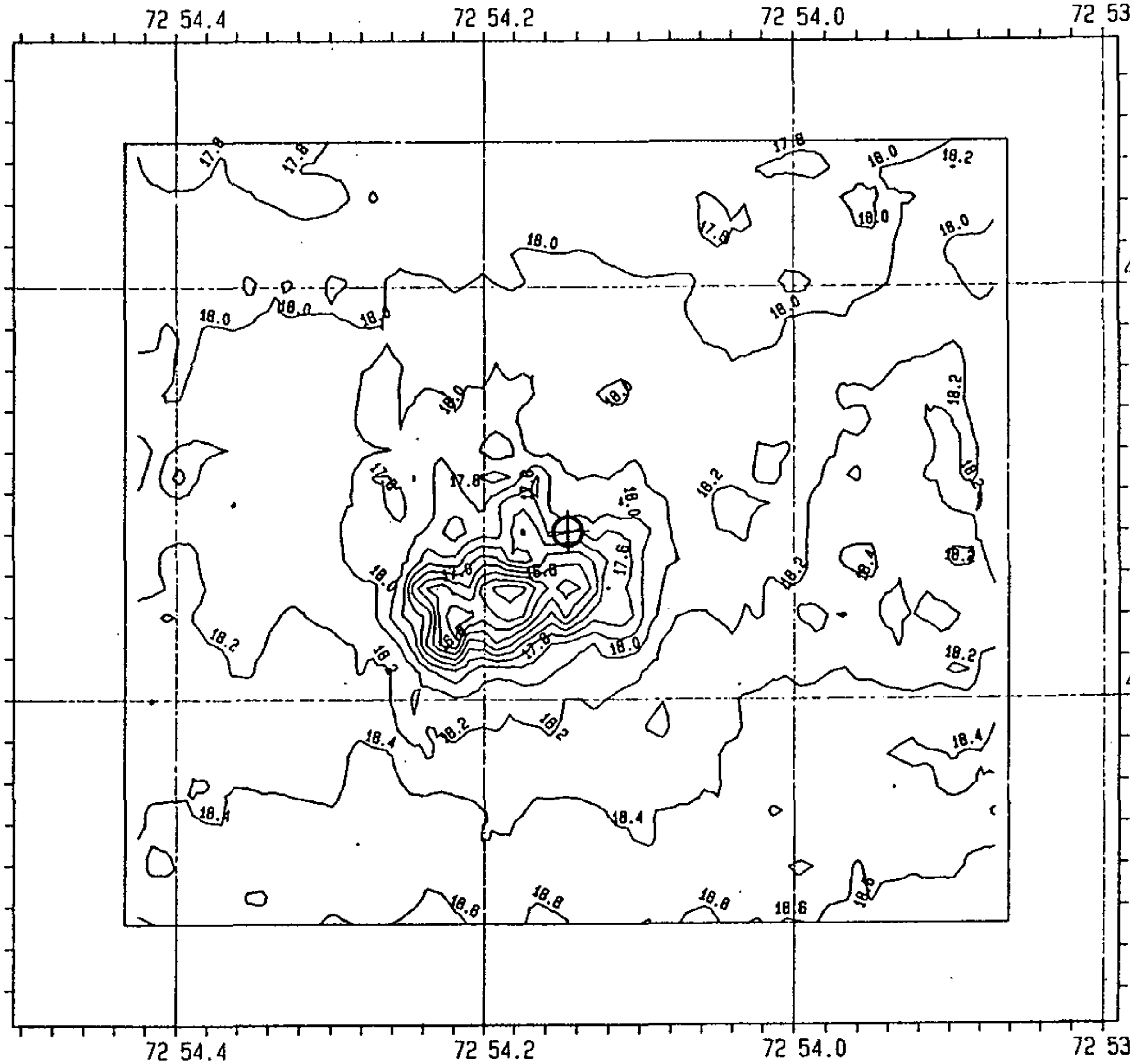

FVP MARCH-APRIL 1984
Lane Interval: 25 m
Vertical Exaggeration: 25X
---------- APRIL 1984
Depth (m)
Distance (m)
Lane 17
Lane 18
Lane 19
Lane 20

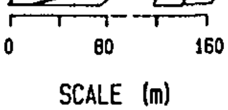
FIGURE II-4-6

CAP SITE #1
POST-DISPOSAL
MONITORING

AUGUST 1983

FIGURE II-4-7





CAP SITE 1

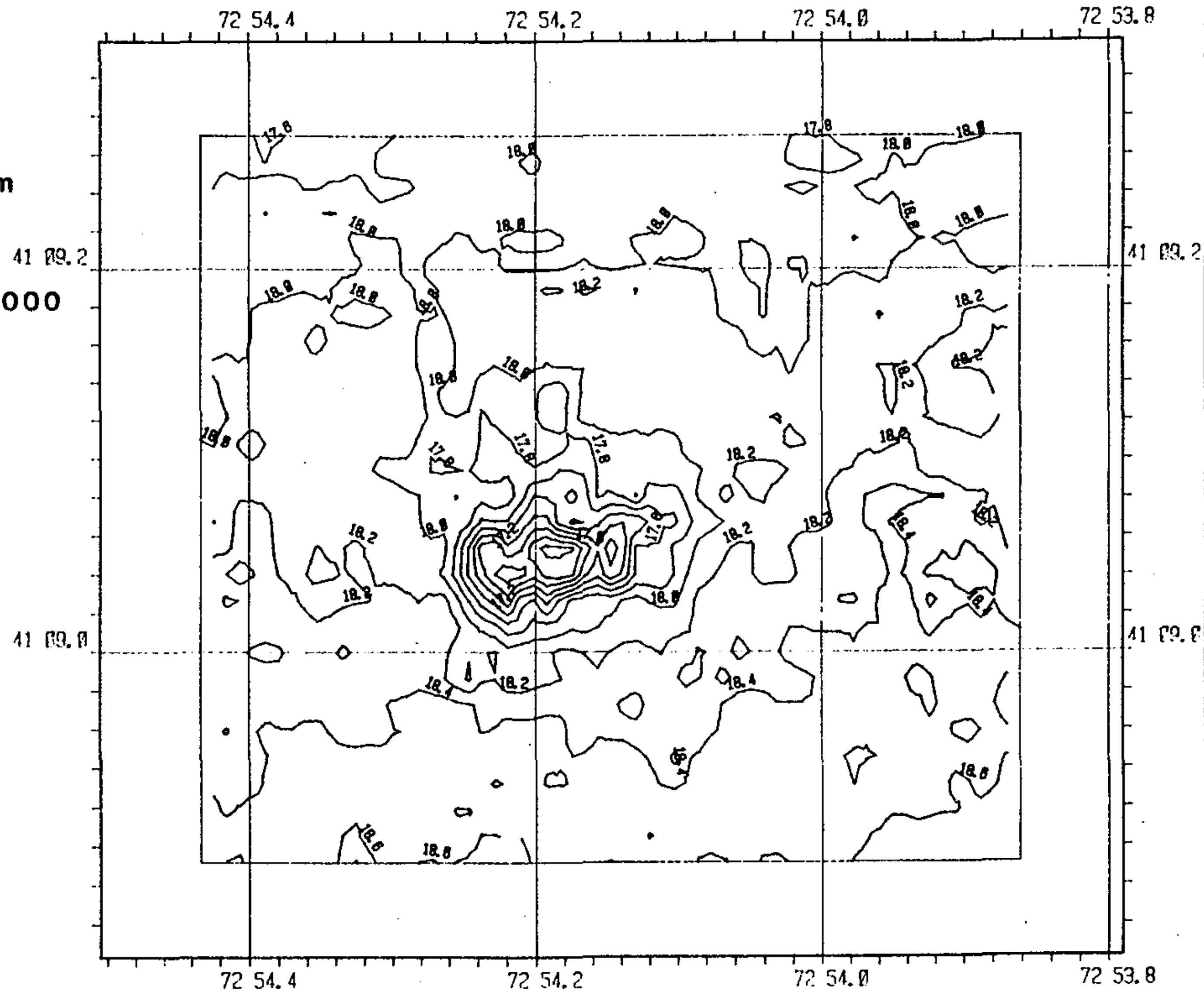
12 APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE:1/4000

DATUM: MLW

FIGURE II-4-8



0 80 160

SCALE (m)

CAP SITE 1

CONTOUR DIFFERENCE

AUG. 1983-APRIL 1984

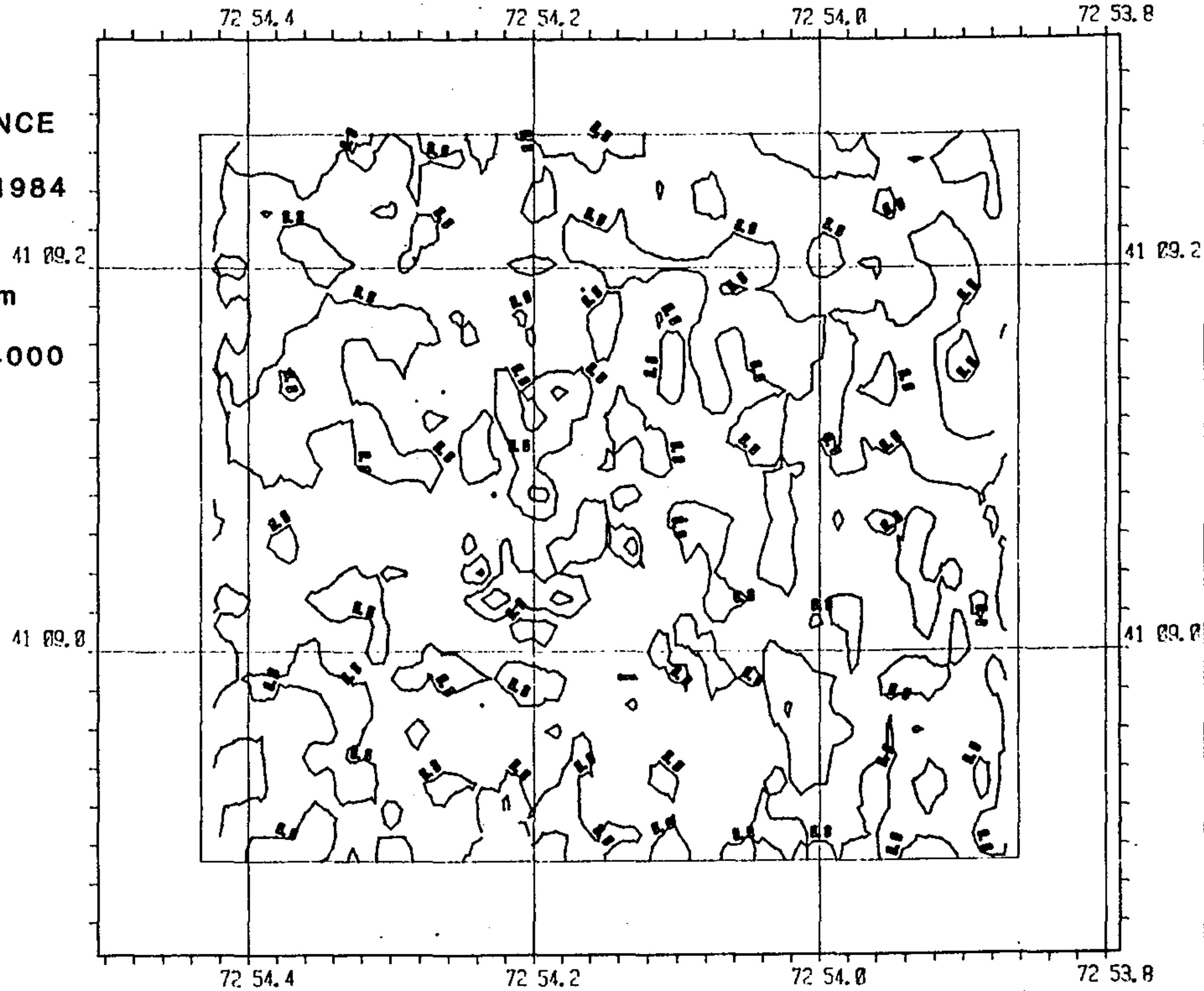
CONTOUR INT: 0.2m

CHART SCALE: 1/4000

FIGURE II-4-9

0 80 160

SCALE (m)



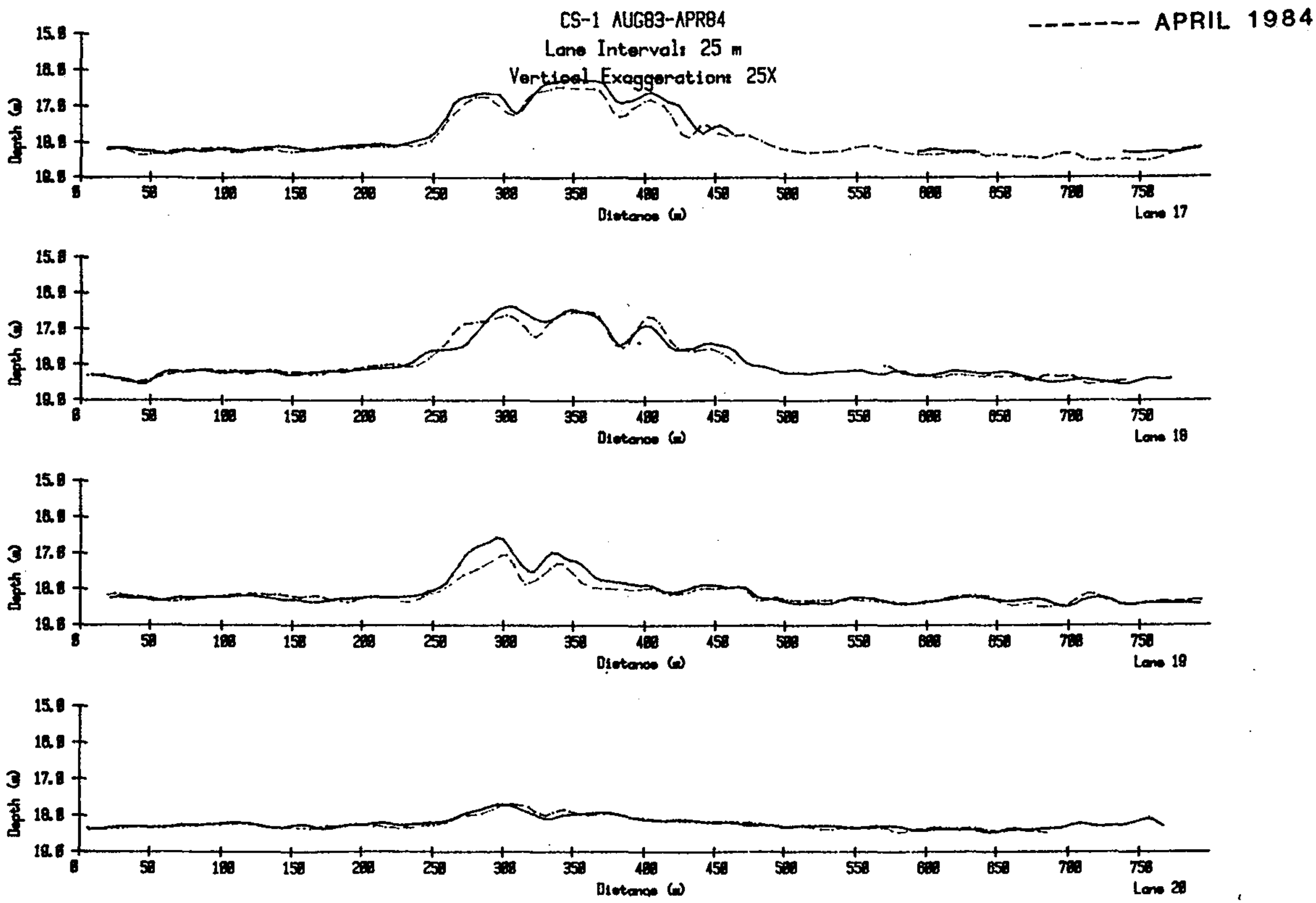


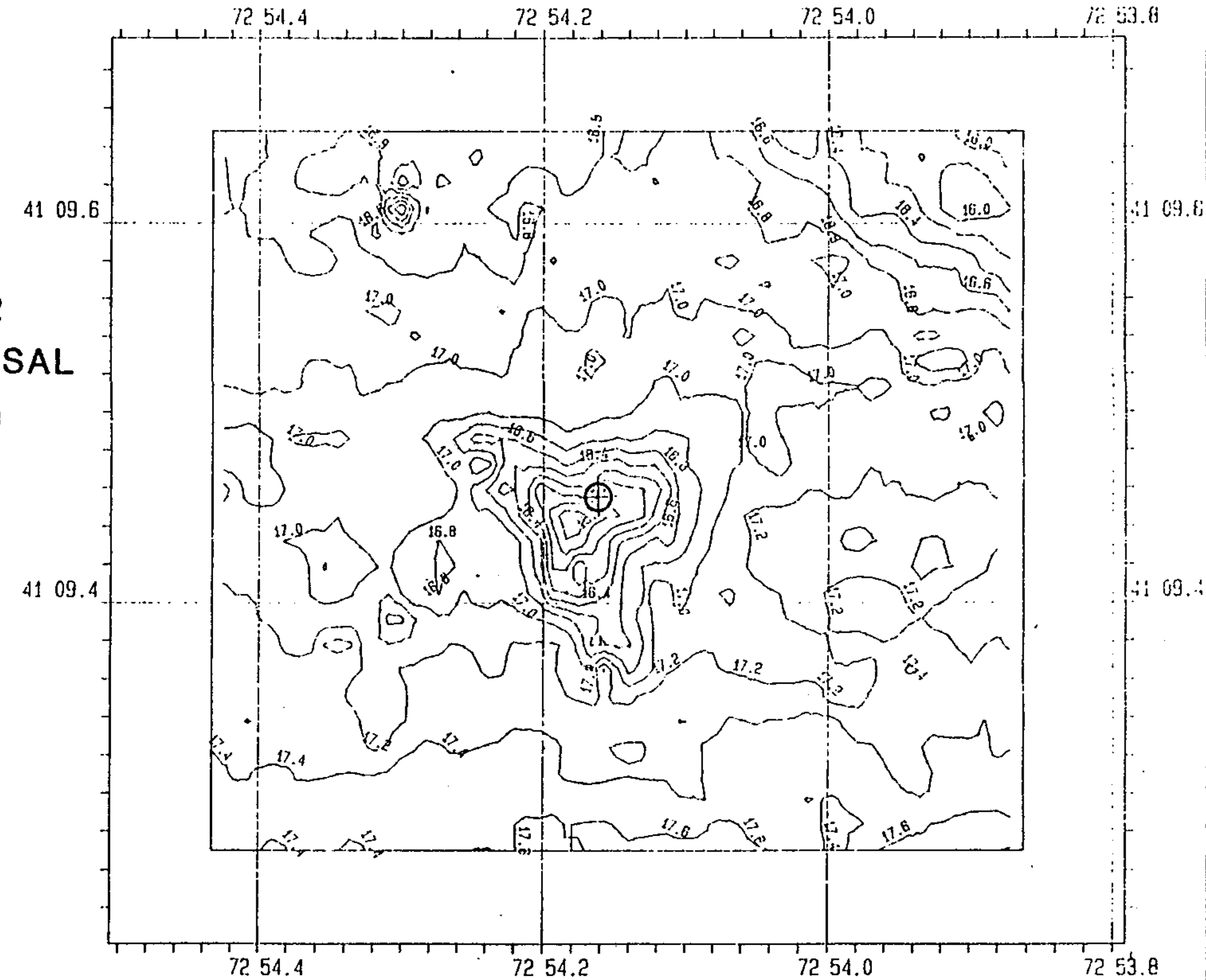
FIGURE II-4-10

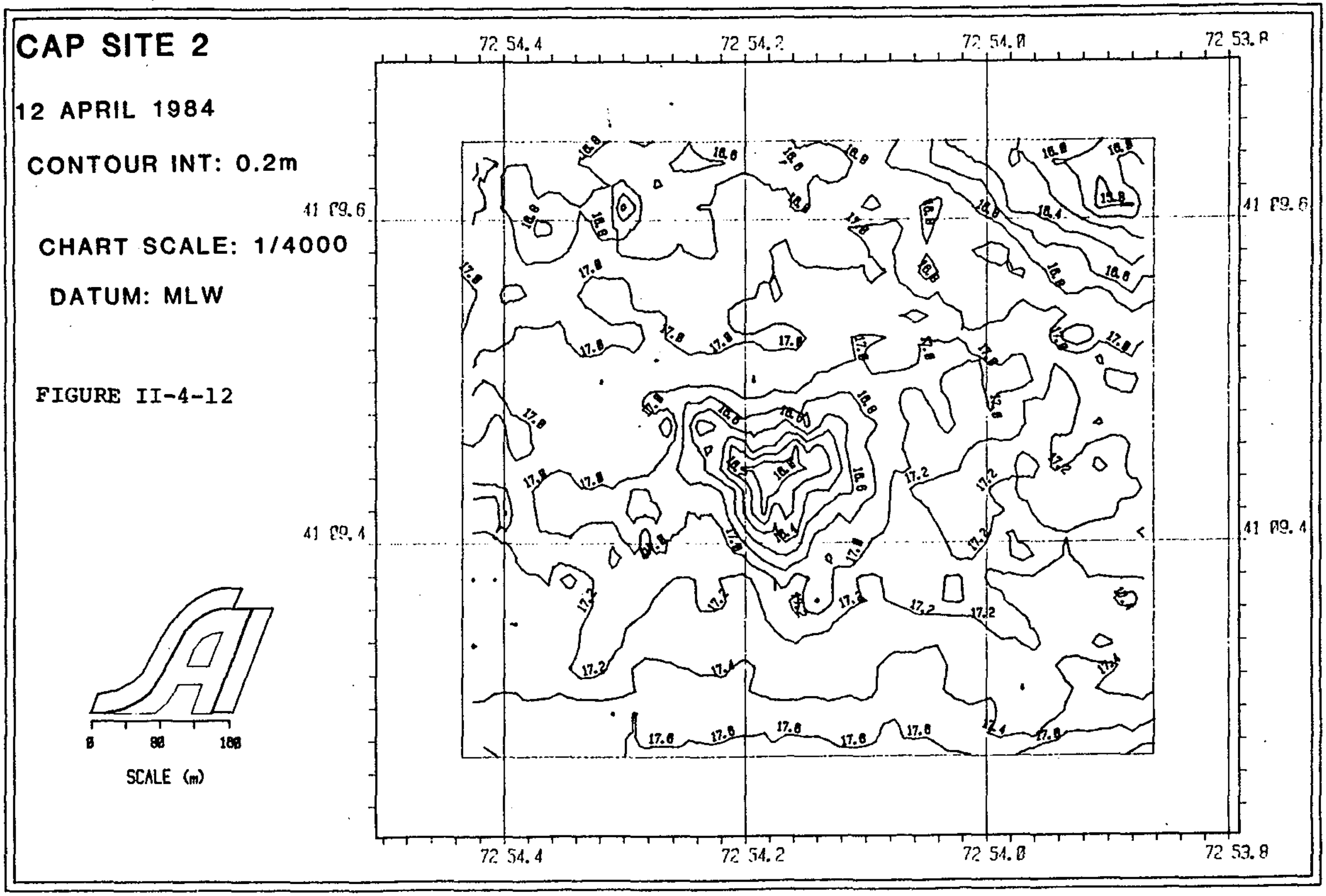
CAP SITE #2
POST-DISPOSAL
MONITORING

AUGUST 1983

FIGURE II-4-11

0 80 160
SCALE (m)





CAP SITE 2
12 APRIL 1984
CONTOUR INT: 0.2m
CHART SCALE: 1/4000
DATUM: MLW
FIGURE II-4-12
72 54.4
72 54.2
72 54.0
72 53.8
41 09.6
41 09.4
SCALE (m)

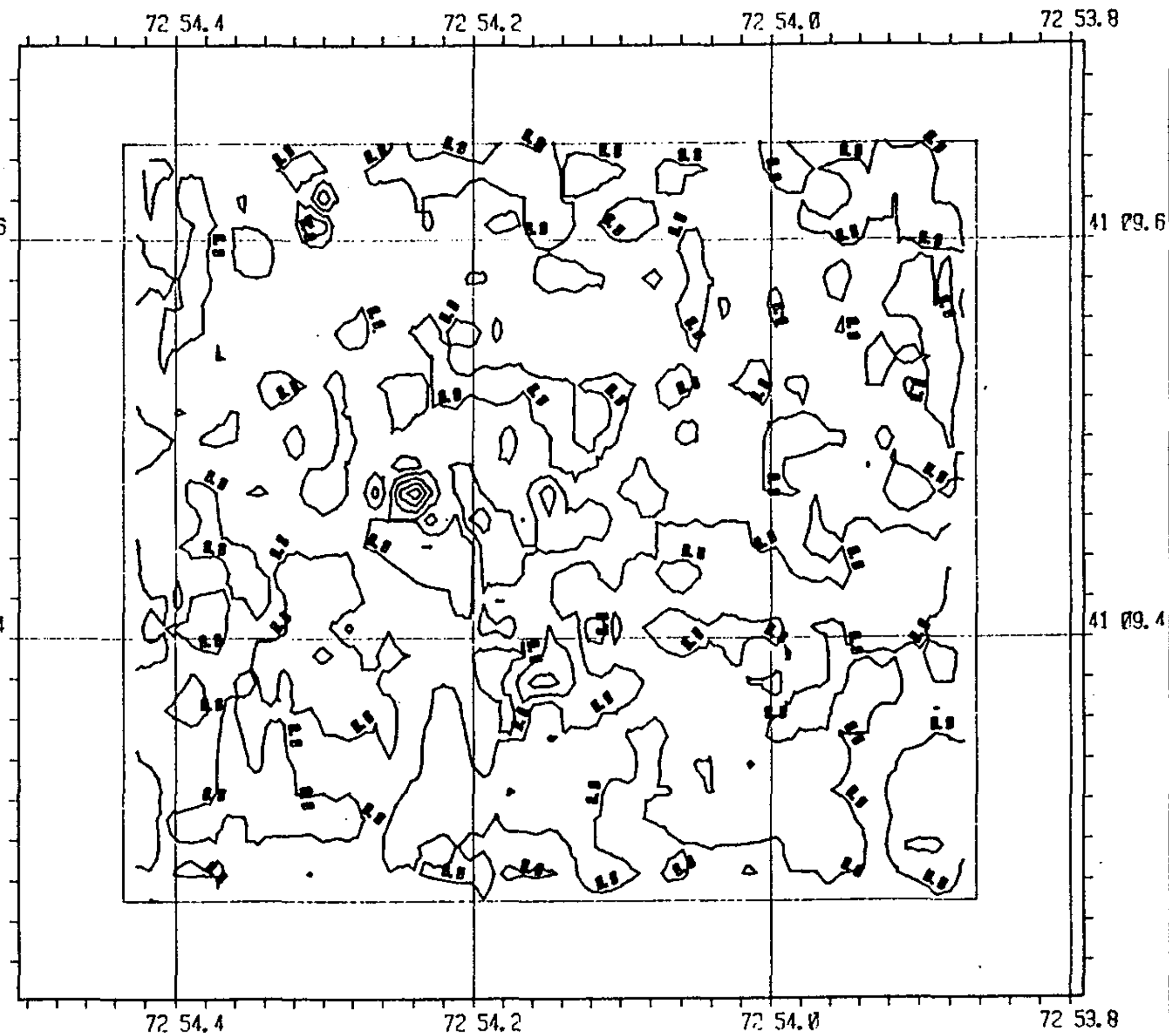
CAP SITE 2

CONTOUR DIFFERENCE
AUG. 1983-APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE: 1/4000

FIGURE II-4-13



0 50 100
SCALE (m)

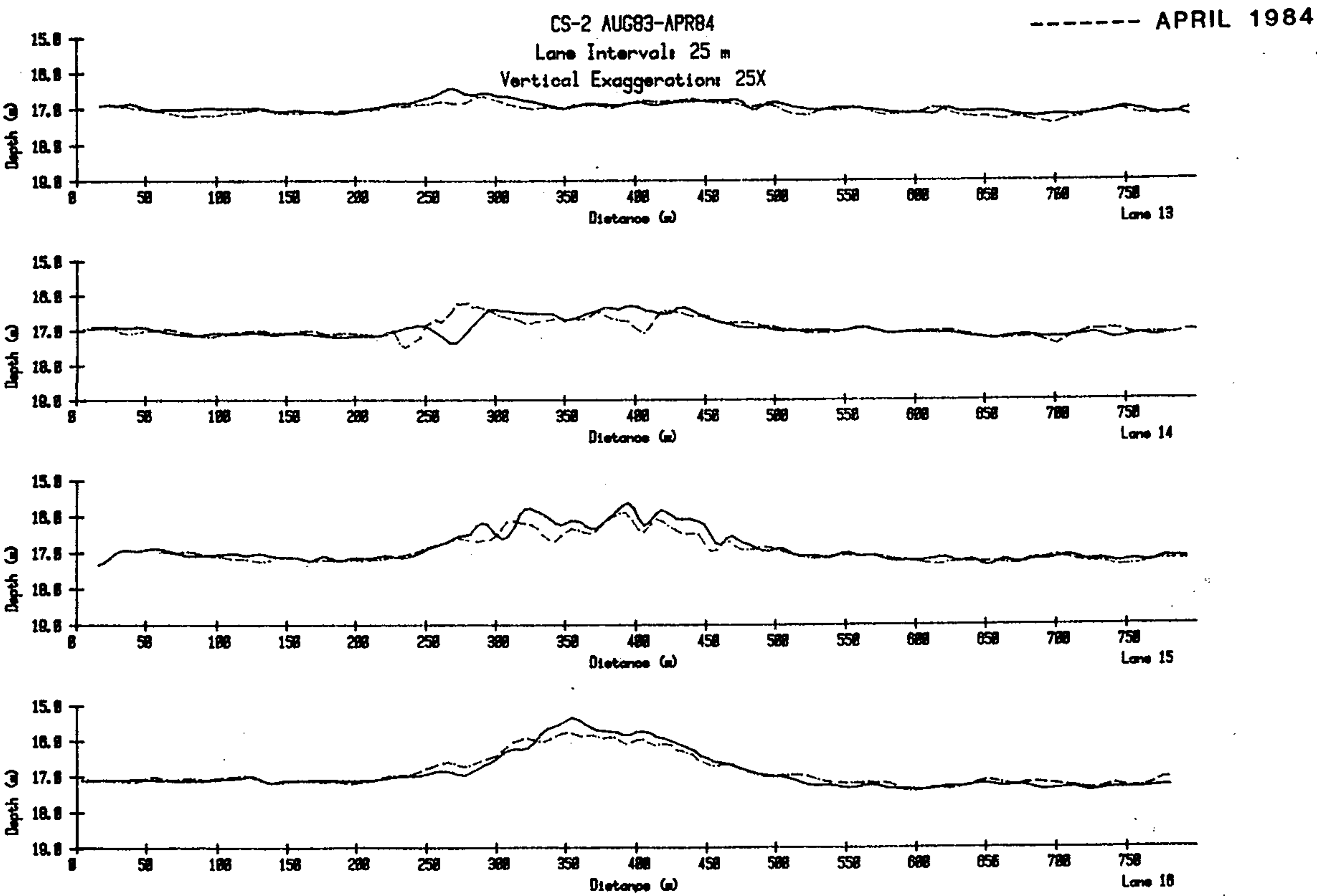


FIGURE II-4-14a

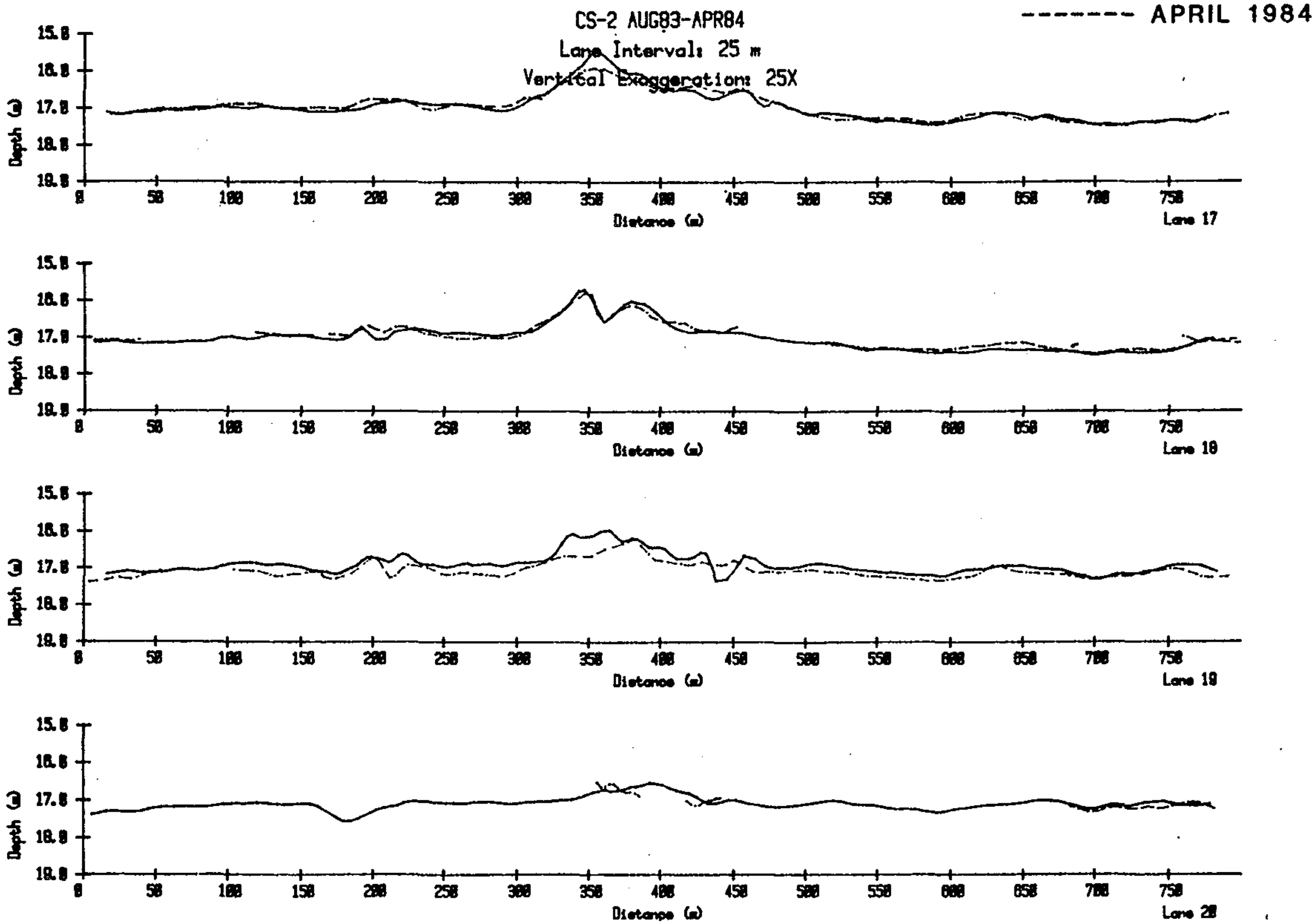


FIGURE II-4-14b

indicating that sediment has in fact moved to the west in that area. Further to the south (profiles 17 and 18), the topographic expression remains fairly consistent, suggesting stability in that area. The total volume difference between the August and April surveys is approximately 5000 m^3, however, the variability on a lane by lane basis is quite high suggesting that some movement has occurred at this site.

4.3.4 STNH-S

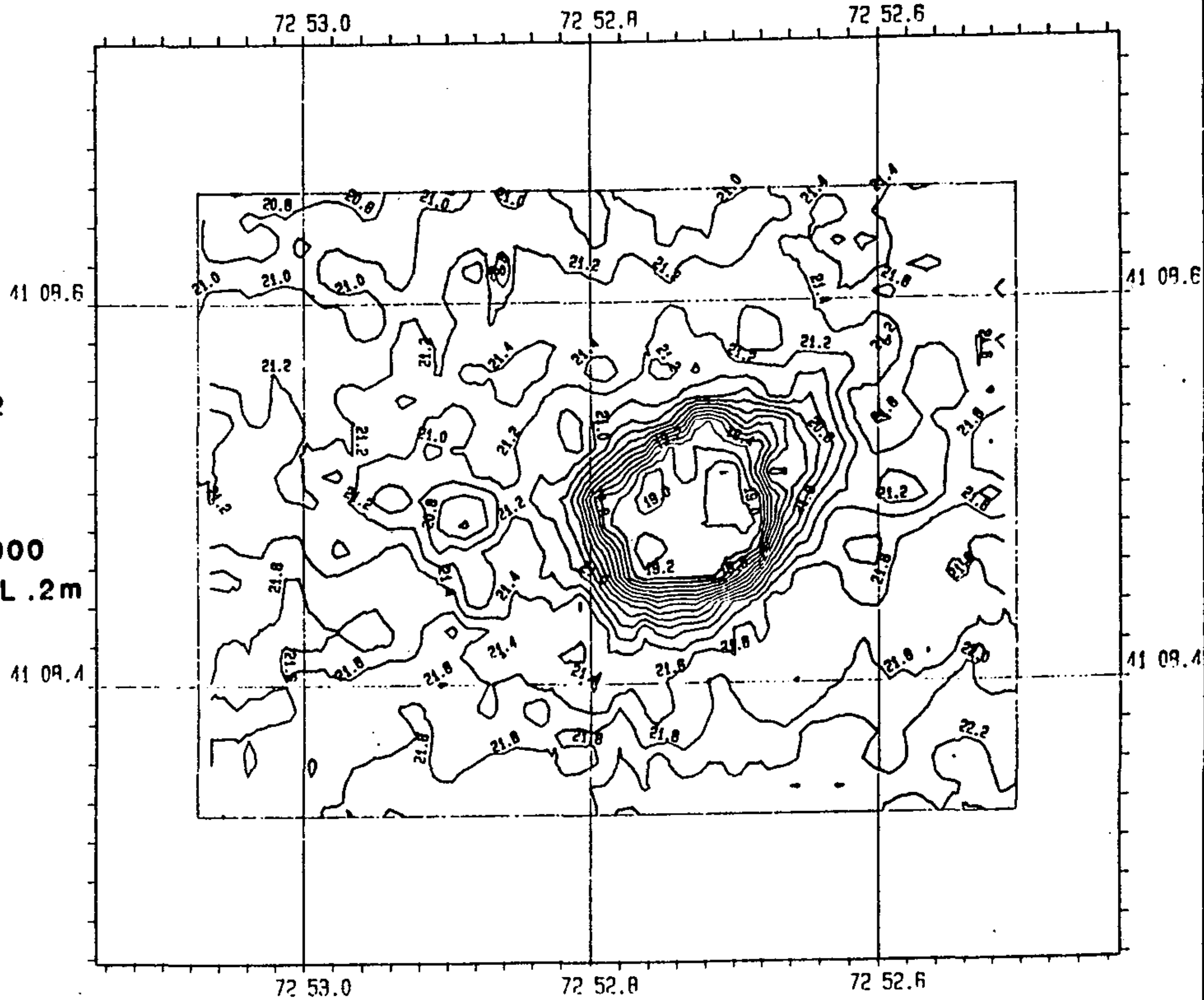
The Stamford/New Haven mounds were deposited during 1979, and monitored closely through 1981. They are now being examined on a yearly basis to determine long term trends. As a result, the last survey available for comparison with the recent survey is December 1982 (Fig. II-4-15). This survey indicates that the STNH-S mound is a steep-sided deposit with the a upper surface at a depth of 19.2 m. This flat surface is thought to be a result of erosion during Hurricane David in September 1979 (Morton, 1980). The post-storm survey (Fig. II-4-16) shows rermarkably little change over the period of more than one year between surveys. The flat surface remains at a depth of 19.2 meters and the lateral extent of the mound remains approximately the same. The contour difference chart (Fig. II-4-17) and the vertical profiles (Fig. II-4-18) do indicate some change on the eastern margin of the mound, where some slumping may have occurred. However, there are no significant changes in sediment distribution at the site, and no apparent effect from the storm event.

4.3.5 STNH-N

The STNH-N mound consists of sand material covering Stamford sediment. This mound was not affected significantly by Hurricane David and the December 1982 survey (Fig. II-4-19) is relatively unchanged from the original post-disposal survey in June 1979. The April 1984 survey (Fig. II-4-20) has generally the same configuration as the previous survey, however, there does appear to be an increase in the slope on the southern side of the mound. This is reflected on the contour difference chart (Fig. II-4-21) as a series of contours on the southern margin of the mound, and on the vertical profiles (Fig. II-4-22) as a depth increase on lanes 13 through 15 and a decrease on lane 16. It appears that again a slumping or displacement of sediment may have occurred at this site.

4.3.6 NHAV-83

During the late fall of 1983, disposal of dredged material took place ath the New Haven 1983 (NHAV-83) disposal site in CLIS. A post disposal survey on 20 December 1983 (Fig. II-4-23) revealed a low broad mound was deposited with a minimum depth of 20 meters and a thickness of about 1 meter. This mound was not a distinct topographic feature and consequently the chart derived from the post-storm survey (Fig. II-4-24) does not have any striking differences. The contour difference chart (Fig. II-4-25) shows a highly variable bottom characteristic of errors



STNH-S

DECEMBER 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE II-4-15

0 80 160

SCALE (m)

STNH-S

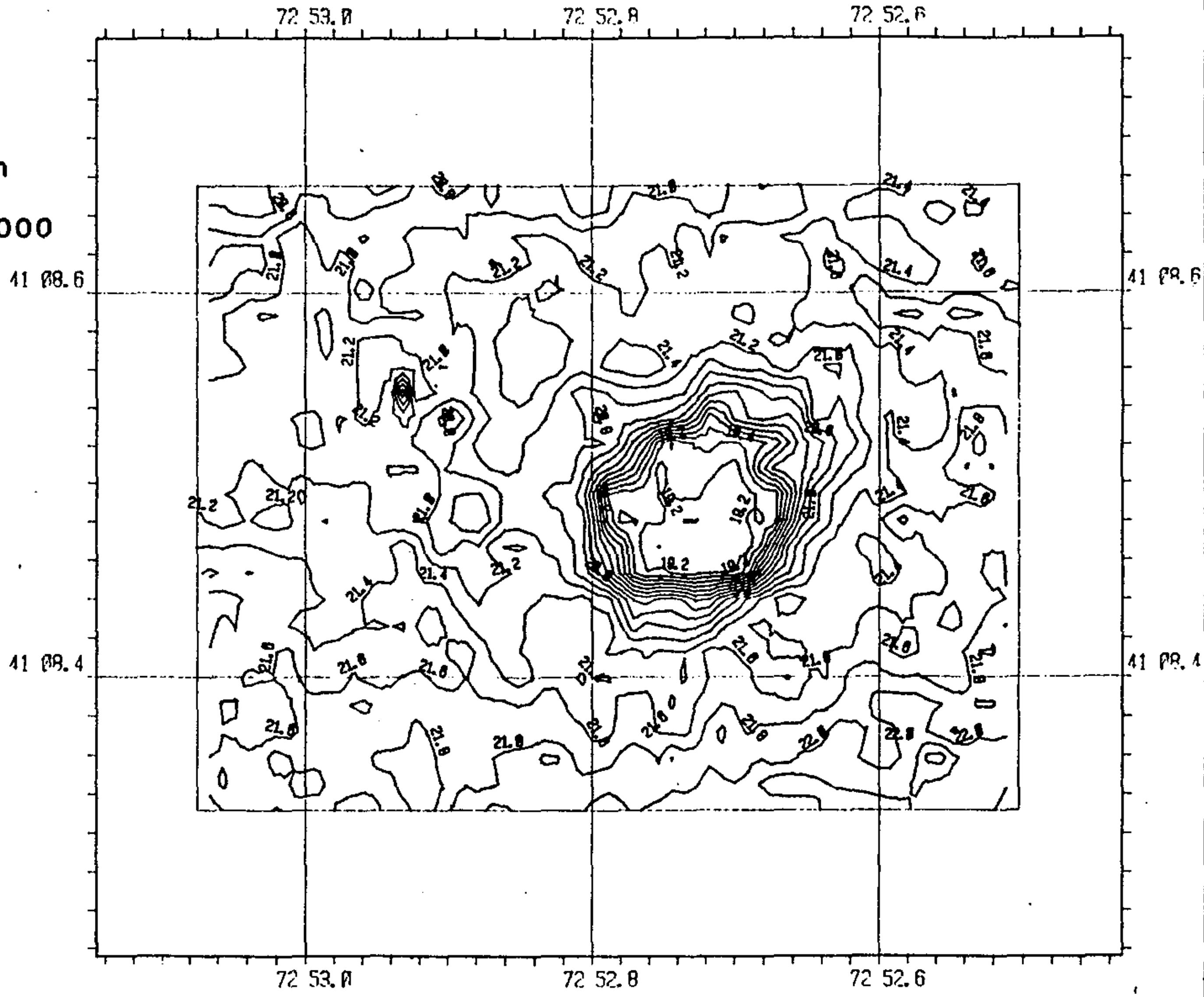
13 APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE: 1/4000

DATUM: MLW

FIGURE II-4-16



0 80 160

SCALE (m)

STNH-S

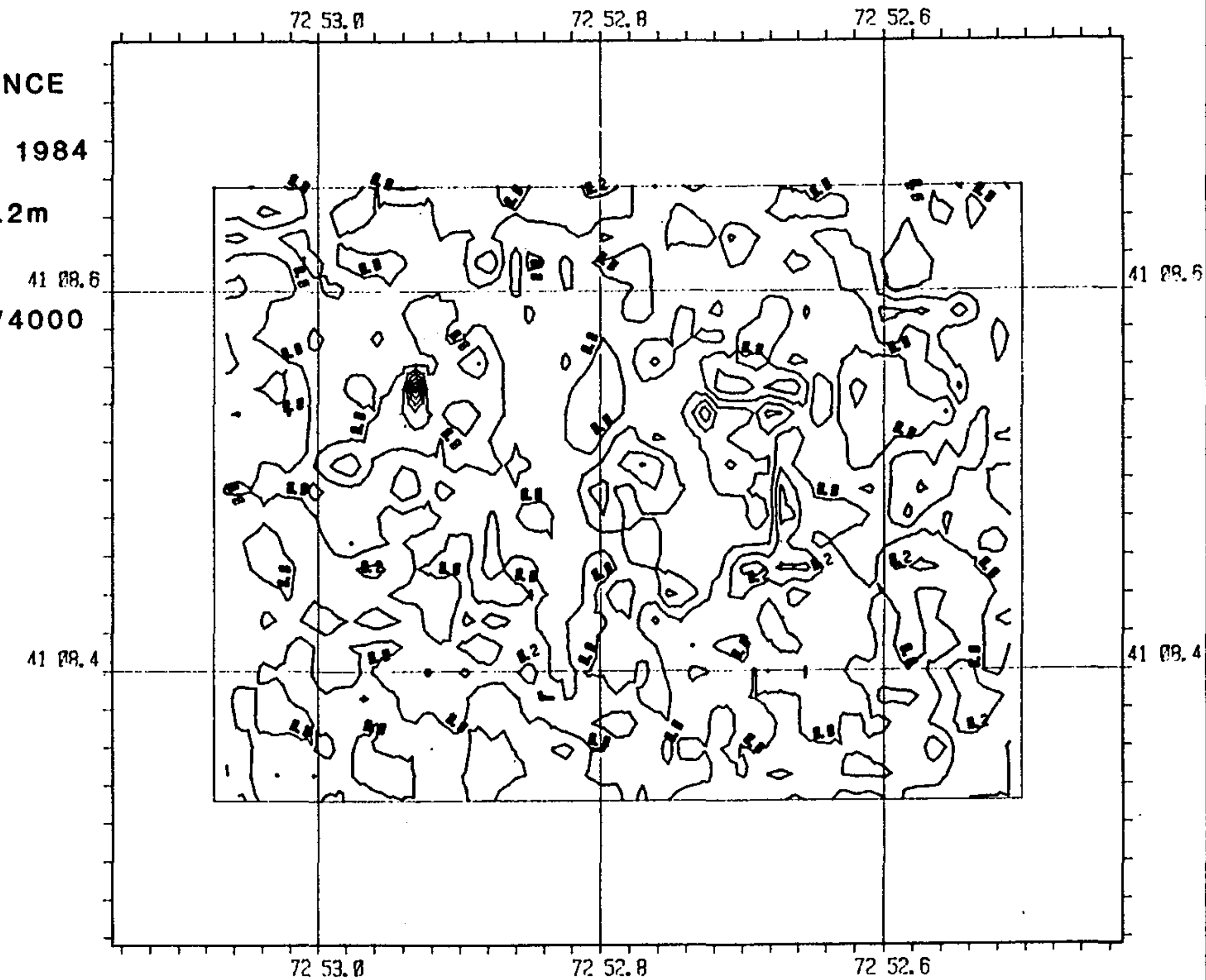
CONTOUR DIFFERENCE

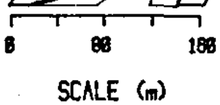
DEC. 1982-APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE: 1/4000

FIGURE II-4-17





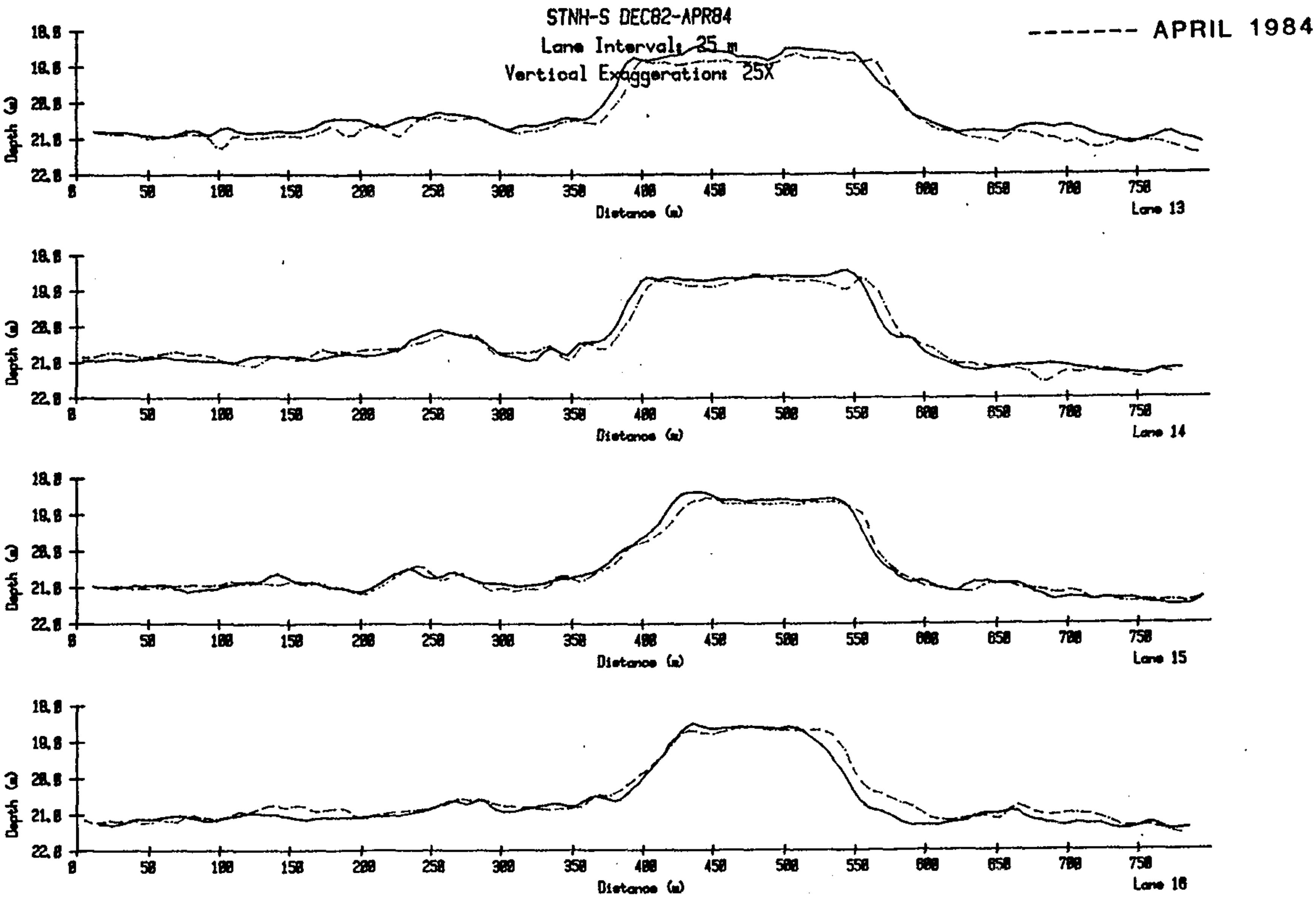


FIGURE II-4-18

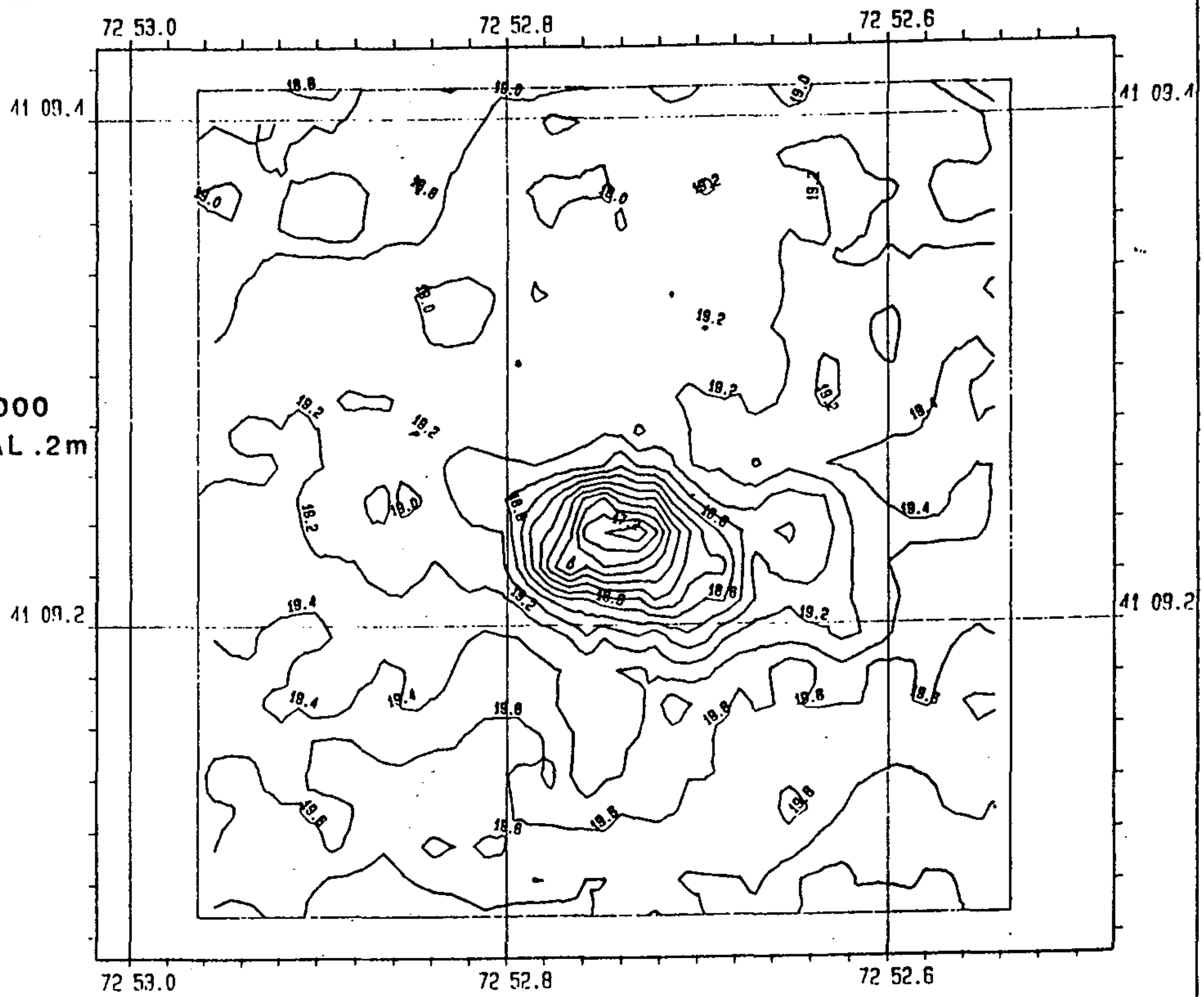
STNH-N

DECEMBER 1982

CHART SCALE 1/4000
CONTOUR INTERVAL .2m

FIGURE II-4-19

0 60 120
SCALE (m)



STNH-N

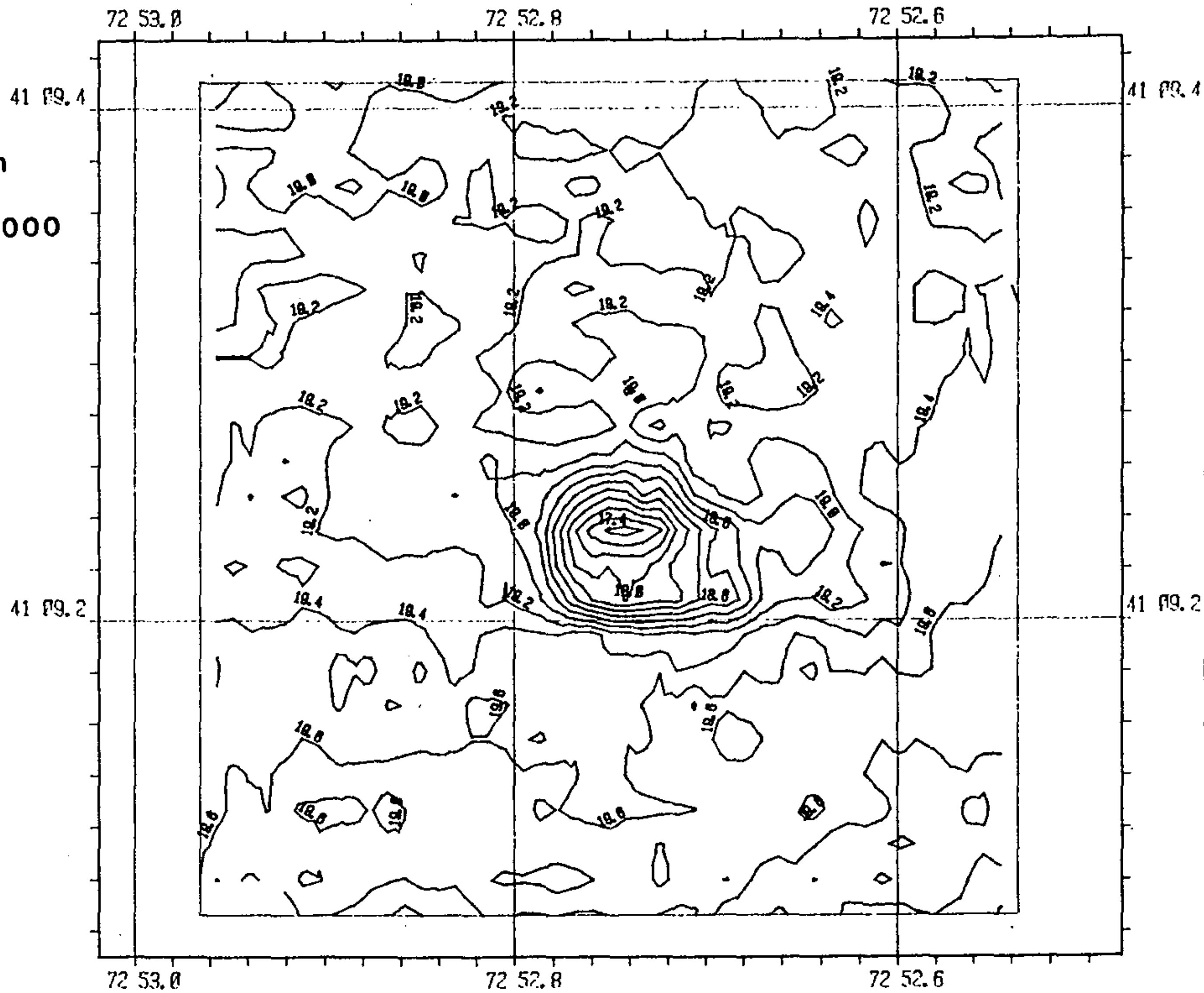
12 APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE: 1/3000

DATUM: MLW

FIGURE II-4-20



0 60 120

SCALE (m)

STNH-N

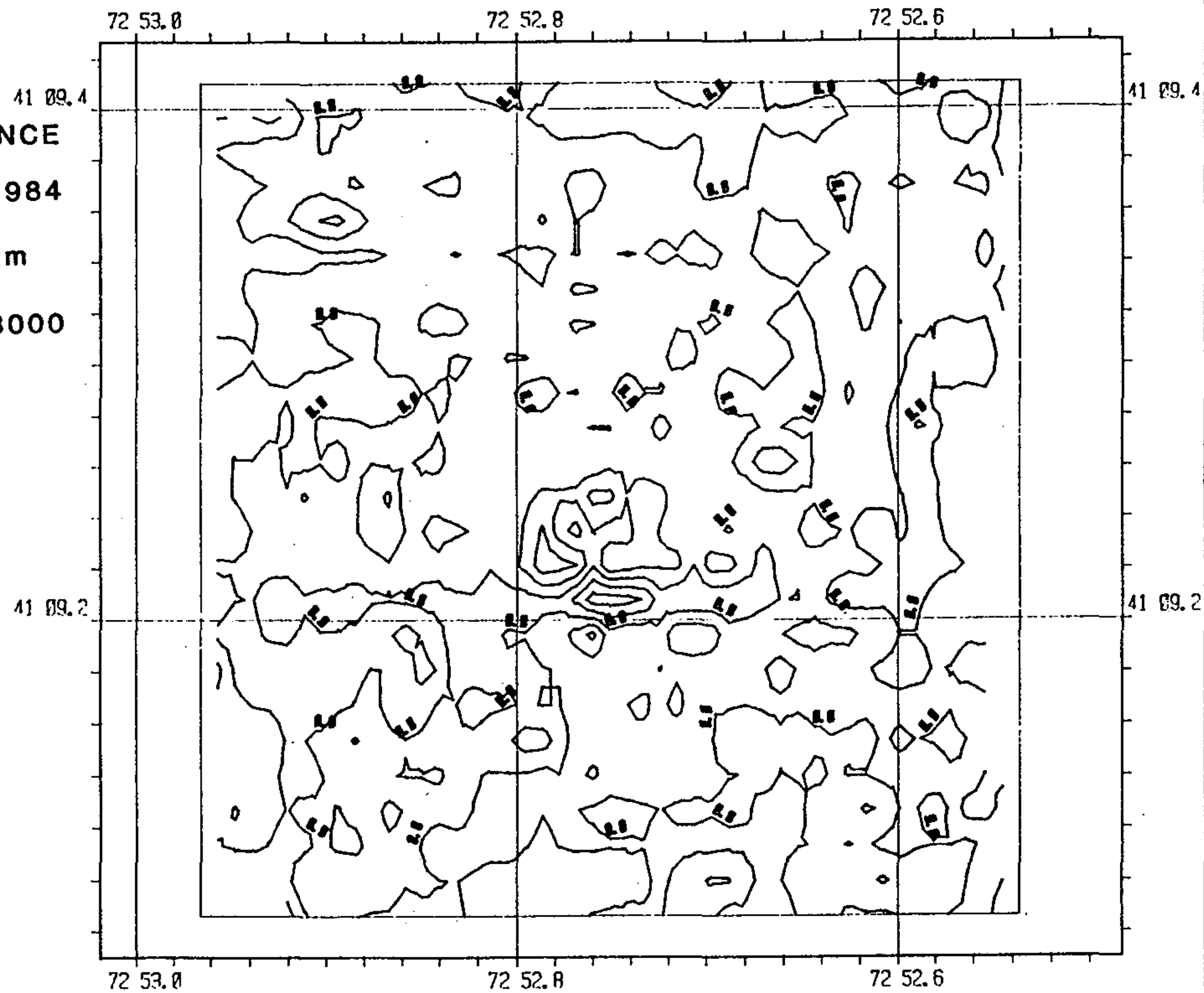
CONTOUR DIFFERENCE

DEC. 1982-APRIL 1984

CONTOUR INT: 0.2m

CHART SCALE: 1/3000

FIGURE II-4-21



0 60 120

SCALE (m)

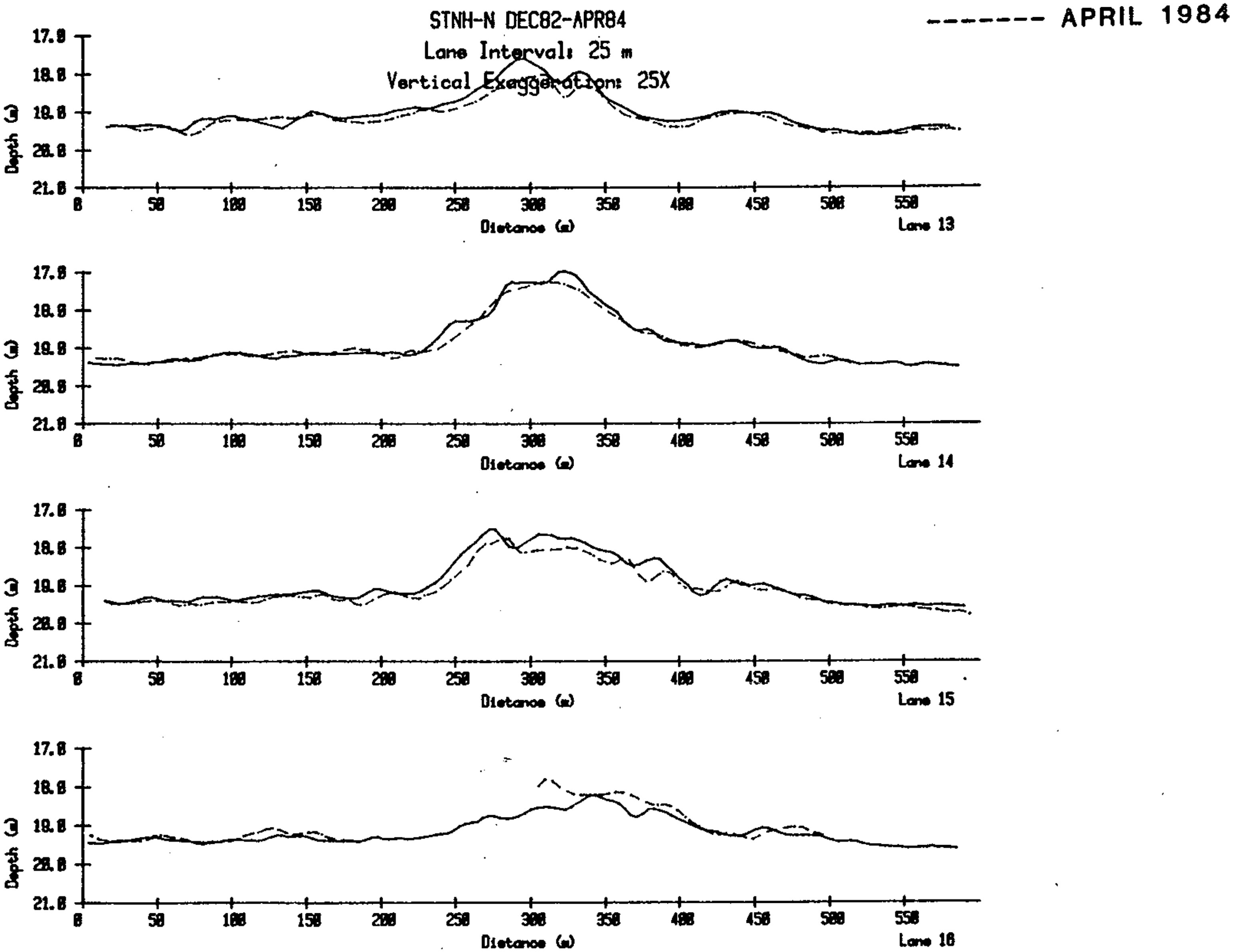


FIGURE II-4-22

NEW HAVEN 1983

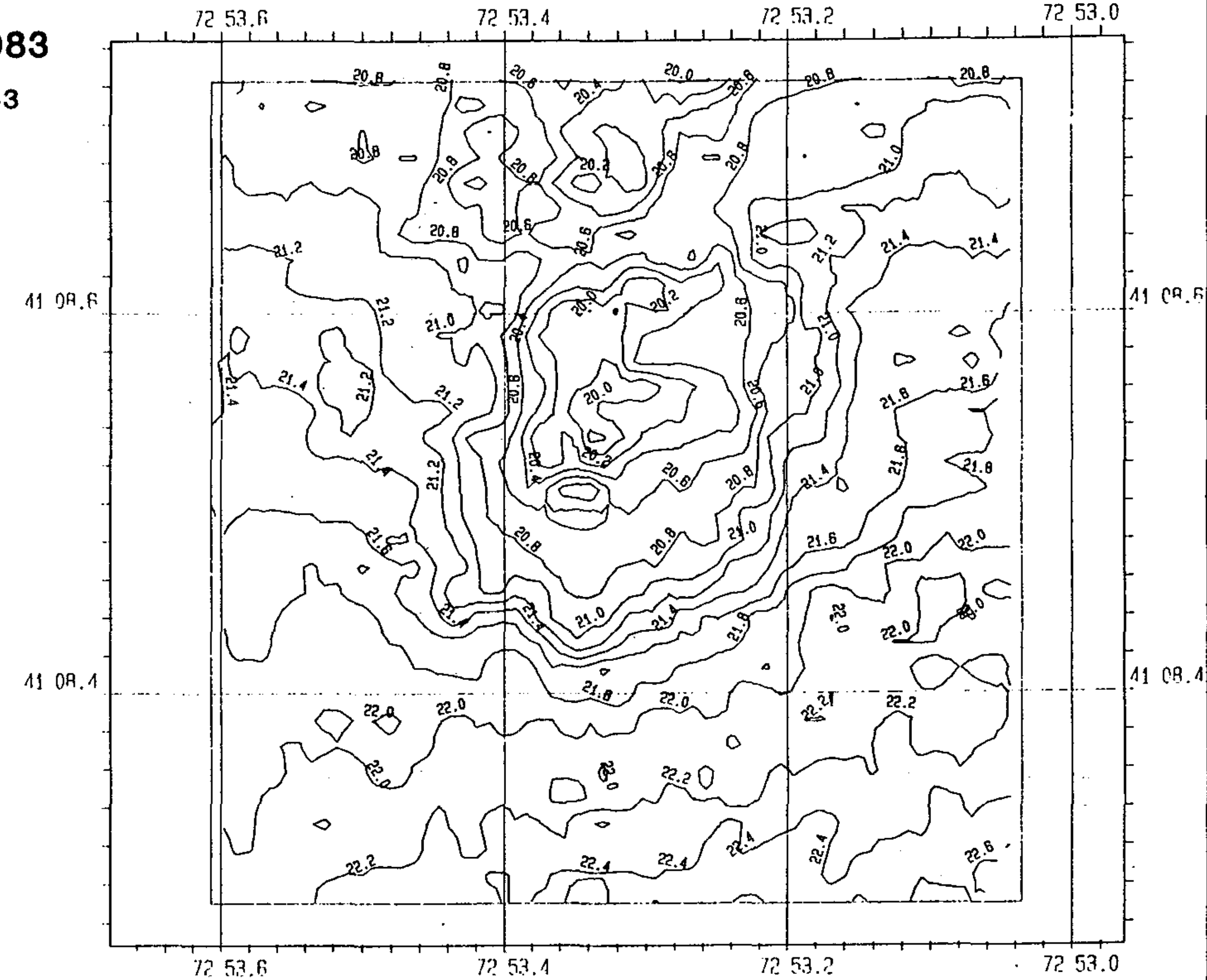
20 DECEMBER 1983

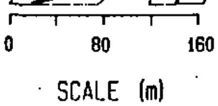
INTERVAL: 0.2m

SCALE: 1/4000

DATUM: MLW

FIGURE II-4-23





NEW HAVEN 1983

11 APRIL 1984

INTERVAL: 0.2m

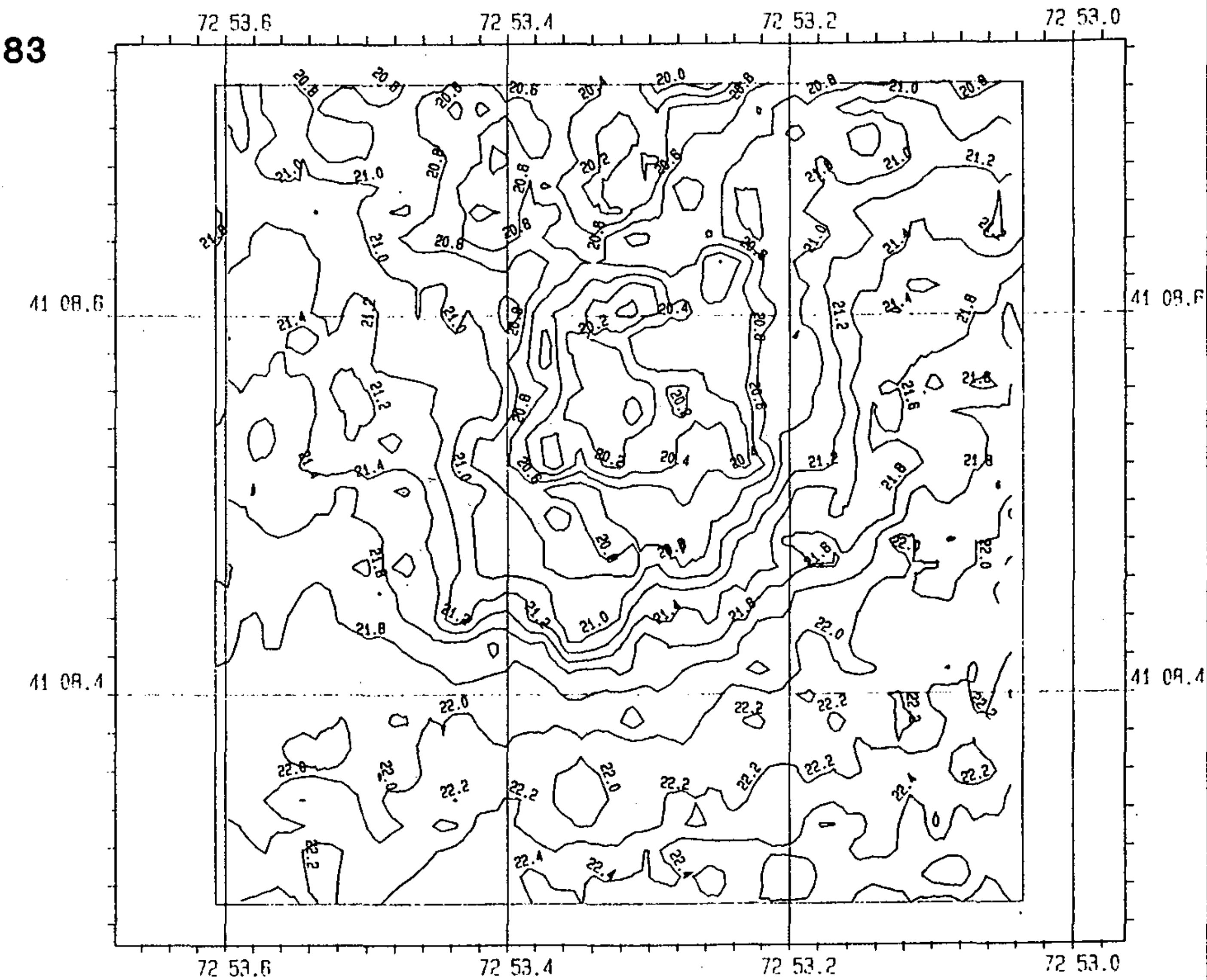
SCALE: 1/4000

DATUM: MLW

FIGURE II-4-24

0 80 160

SCALE (m)



NEW HAVEN 1983

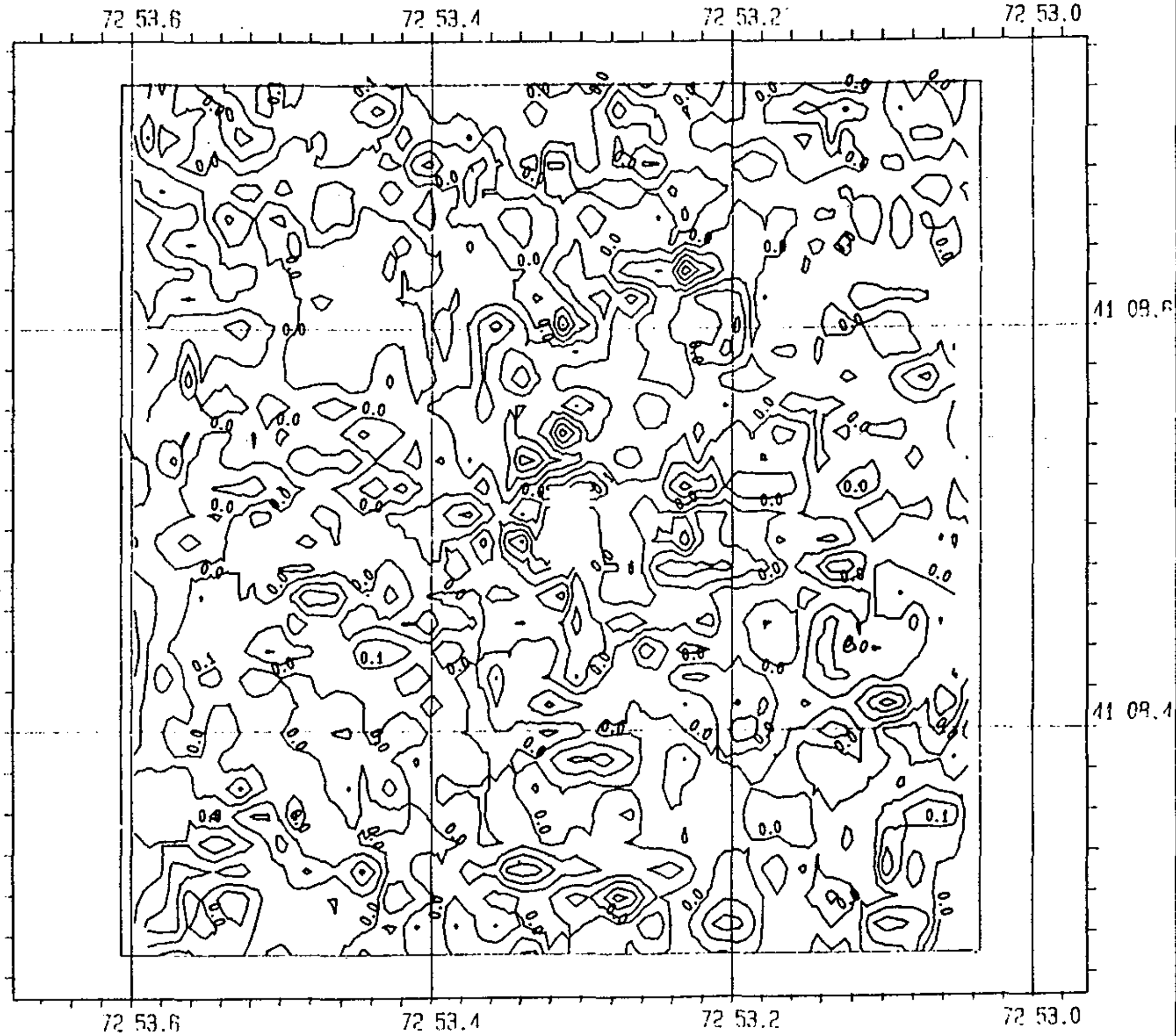
CONTOUR DIFFERENCE

APR84-DEC83

INTERVAL: 0.1m

SCALE: 1/4000

FIGURE II-4-25



0 80 160

SCALE (m)

introduced when calibrations between surveys cannot be effectively accomplished. Figures II-4-26a and b show the distribution of sediment at this site delineating the broad shallow mound. It is apparent that slight changes in depth occur over the entire area, but no major loss of sediment has occurred.

4.3.7 Summary and Conclusions

The results of the bathymetric surveys conducted after the passage of the storm event indicate quite conclusively that the CLIS disposal area can be classified as a containment site. In virtually all cases, no significant erosion of the disposal mounds was observed which could be attributed to this storm. However, before a complete statement as to the containment capability of the site can be made, the energy level of the storm should be quantified though the DAISY measurements.

It should also be pointed out that several of the sites (FVP, CS #1, CS #2 and STNH-N) have depths less than the 19 meter leve, that was produced at the STNH-S site during Hurricane David, and therefore could be expected to erode under strong conditions. However, all of these deposits have been in place for nearly a year, and have had time to consolidate and develop a sediment-water interface in equilibrium with the environment. This was not the case with the STNH-S mound, where the storm occurred less than six months after disposal.

Furthermore, it appears that the sand caps seem to be more prone to changes in topography which may result from slumping or compression of the capped material. Both CS #2 and STNH-N have evidence of changes on the margins of the disposal mound. Such slumping is not restricted only to sand caps, however, the STNH-S mound has also showed some evidence of slumping on the east margin.

In summary, disposal mounds at the CLIS site appear stable and unaffected by the March storm event. The results fo the DAISY analysis will be combined with the above bathymetric evidence to fully quantify the containment potential of the CLIS site at the DAMOS symposium in January 1985.

5.0 OVERALL SURVEY OF CLIS DISPOSAL SITE

During August 1983, a bathymetric survey of the entire CLIS disposal site was conducted to provide an overview of the site for management purposes. Most of the survey was run with a 50 meter lane spacing, but 25 meter lanes were used over specific survey areas. Figure II-5-1 is a three dimensional plot of the site derived from that survey that shows clearly the major disposal operations at the site as well as areas where material has been spread over the bottom. The flat region to the southeast was not surveyed as no disposal has taken place in that area.

Most disposal operations have taken place in the center

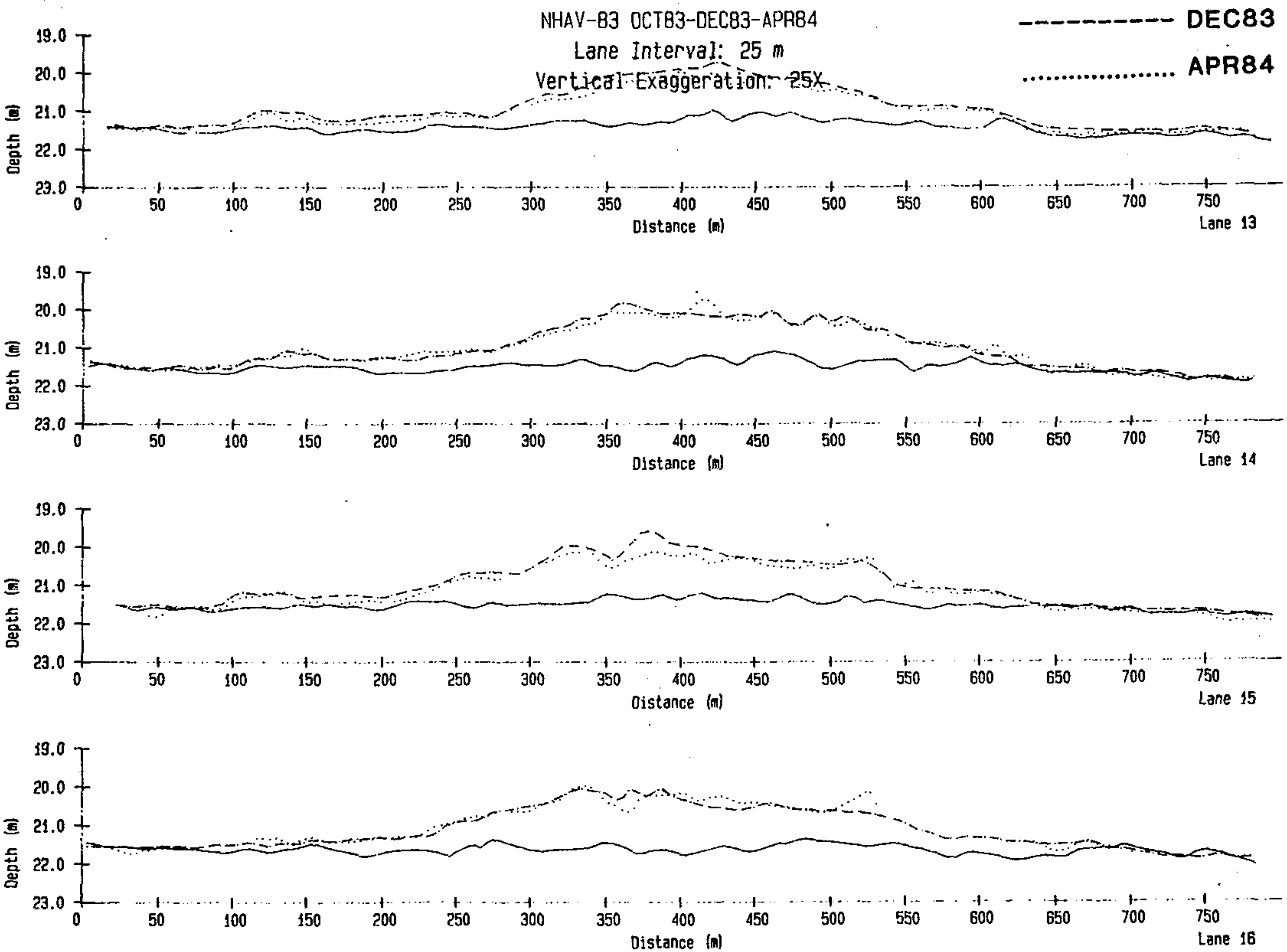


FIGURE II-4-26a

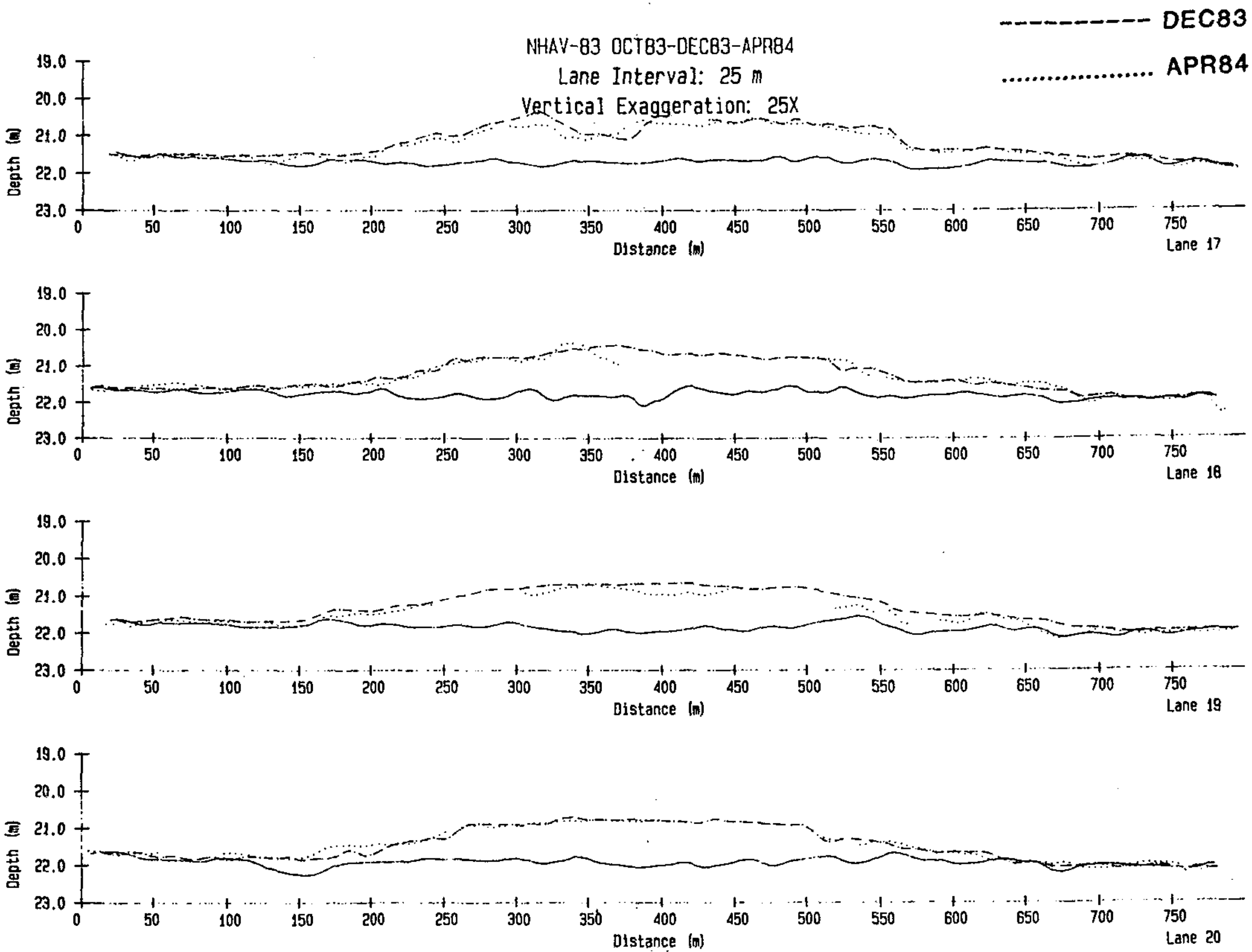


FIGURE II-4-26b

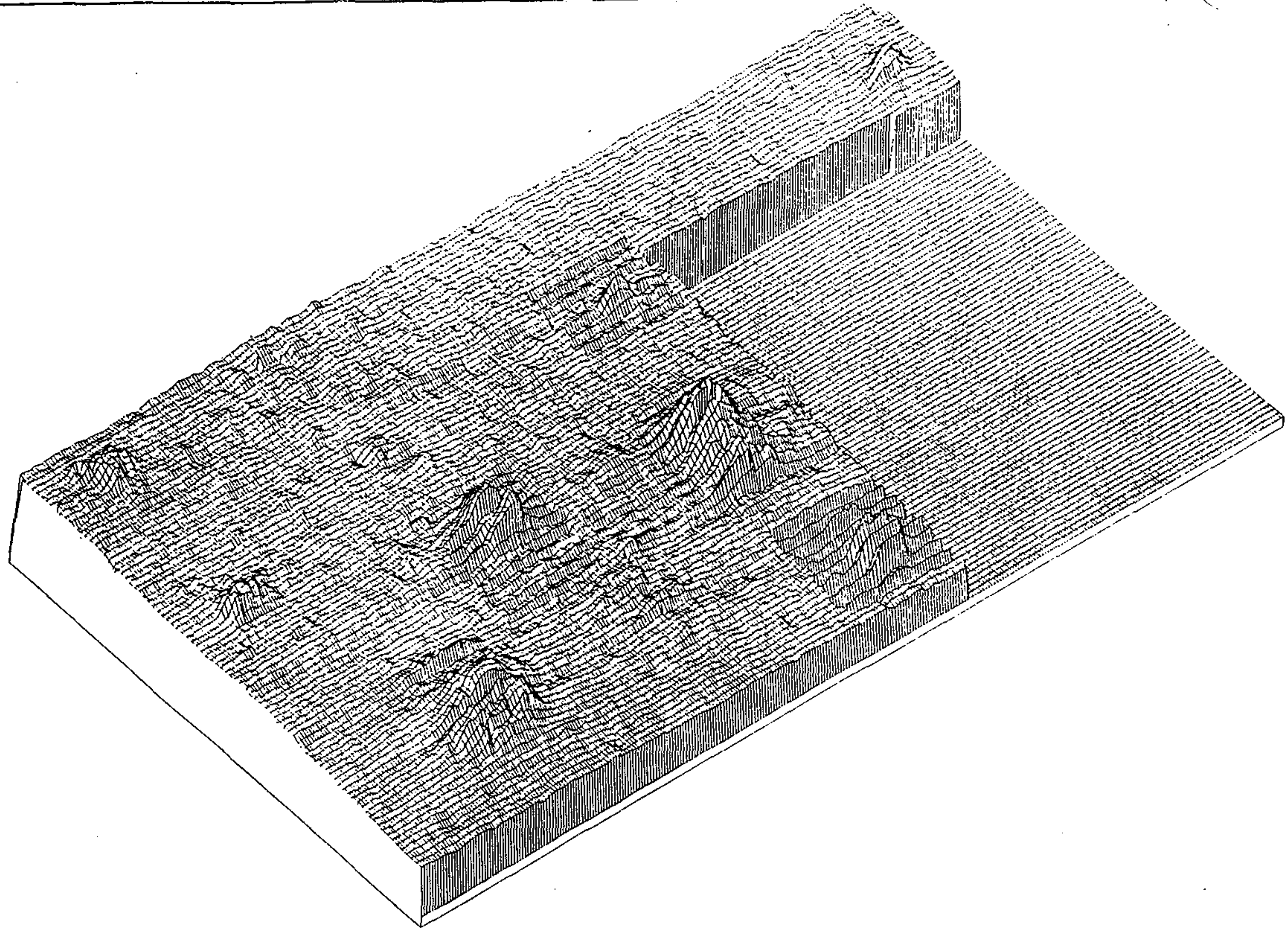


Figure II-5-1. Three dimensional view of Central Long Island Sound Disposal Site, August 1983.

of the site with the New Haven 1974 operation resulting in the largest mound. The "SP" buoy was located to the southeast of that site and during the past several years has accumulated material over a wide area without developing a mound. This wide distribution results from control of disposal using a Coast Guard buoy as a general marker to insure material is dumped within the confines of the disposal site, but not necessarily at a specific point. Conversely, the small size of the other disposal mounds indicates that point dumping can be effectively accomplished to reduce the spread of material.

One important aspect of the presentation is its representation of the relative size and distribution of the disposal mounds. From this view, it is apparent that the FVP mound is located at some distance from other sites and should not be significantly affected by disposal.

A second survey covering the entire site was conducted during September 1984, over the same grid as the 1983 survey. In addition, sediment samples were obtained at all sites to assess the distribution and stability of dredged material throughout the site. Figure II-5-2 is a contour chart of the survey generated with a 25 x 50 m grid resolution and a contour interval of .25 m. Figue II-5-3 is a three dimensional representation of the contour chart with additional smoothing added to generate a realistic impression of bottom topography.

No major changes in topographic features were observed between surveys, however, a new mound has been added northwest of the New Haven 1974 mound, which is composed of material dredged from New Haven Harbor during 1984 and dumped at the "SP" buoy.

Further analysis and characterization of the CLIS disposal site is currently underway and an evaluation of the relationship between topographic features, dredged material distribution and bulk sediment chemistry will be presented at the symposium in January 1984.

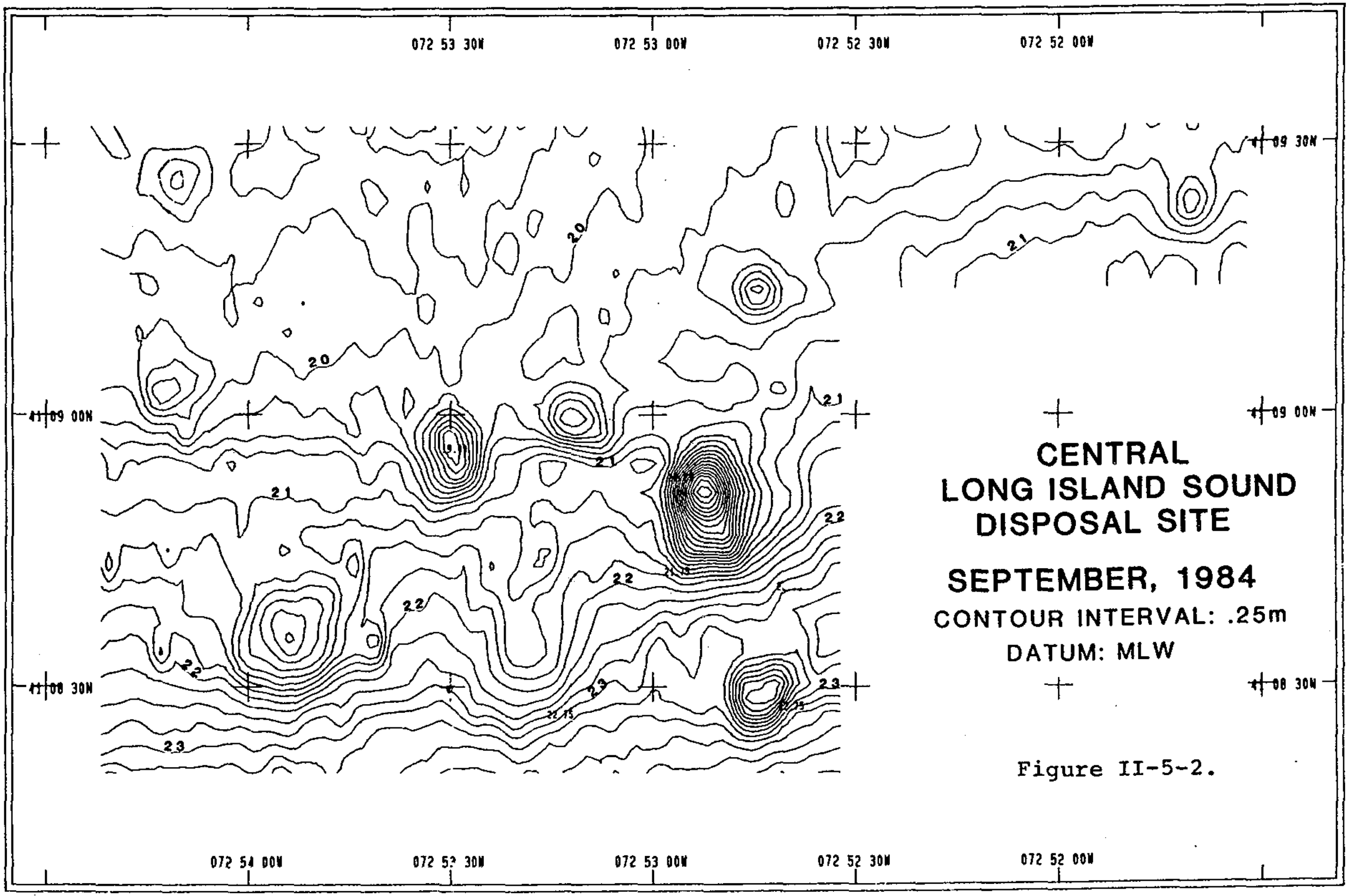

072 53 30W
072 53 00W
072 52 30W
072 52 00W
41 09 30N
41 09 00N
41 08 30N
072 54 00W
CENTRAL
LONG ISLAND SOUND
DISPOSAL SITE
SEPTEMBER, 1984
CONTOUR INTERVAL: .25m
DATUM: MLW
20
21
22
23

Figure II-5-2.

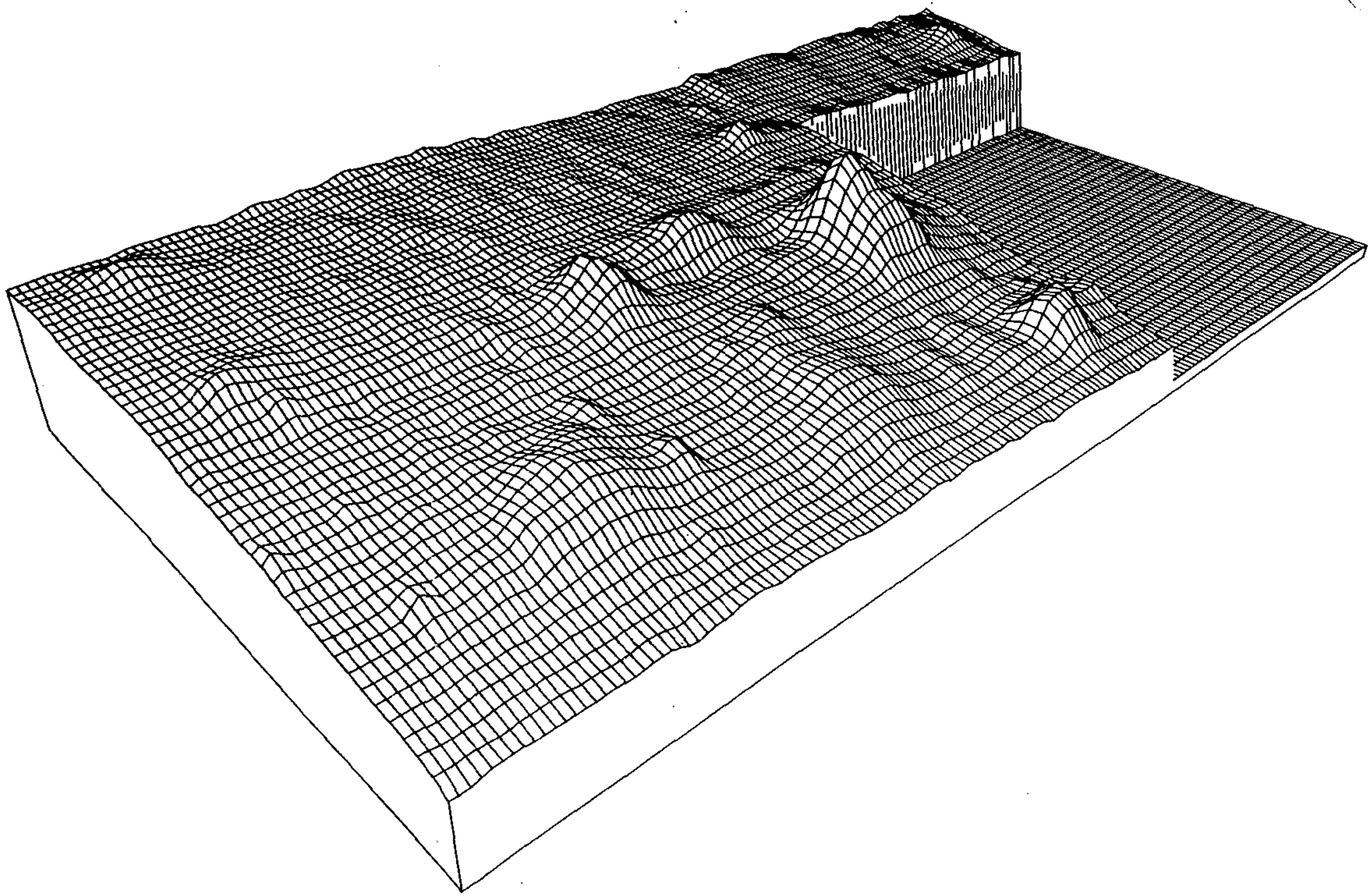


Figure II-5-3. Three dimensional view of Centrâl Long Island Sound Disposal Site, September 1984.

6.0 REFERENCES

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